DRAFT FINAL WORK PLAN
FOR FOCUSED
GROUNDWATER CHARACTERIZATION
ALASKA REAL ESTATE PARKING LOT
ANCHORAGE, ALASKA

ADEC SPAR TERM CONTRACT # 18-8036-13
APRIL 2, 2014

Prepared For:
Alaska Department of Environmental Conservation
Division of Spill Prevention and Response
555 Cordova Street
Anchorage, AK 99501

Prepared By:
Ahtna Engineering Services, LLC
110 West 38th Avenue, Suite 200A
Anchorage, Alaska 99503

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APPROVAL PAGE

This work plan for conducting a focused groundwater characterization at the Alaska Real Estate Parking Lot site in Anchorage, Alaska has been prepared for the Alaska Department of Environmental Conservation by Ahtna Engineering Services, LLC, with support from their teaming partner Geosyntec Consultants, Inc.

ADEC Site Name: Alaska Real Estate Parking Lot
ADEC File No. 2100.38.434

The following people have reviewed and approved this plan.

Work Plan Prepared By:

Ahtna Engineering Services, LLC
Project Manager

Work Plan Reviewed By:

Ben Martich, QEP
Geosyntec Consultants, Inc.
Senior Scientist

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ACRONYMS AND ABBREVIATIONS

AAC .....Alaska Administrative Code
ADEC.....Alaska Department of Environmental Conservation
Ahtna.....Ahtna Engineering Services, LLC
AREPL.....Alaska Real Estate Parking Lot
ARRC.....Alaska Railroad Corporation
ASTM .....American Society of Testing and Materials
°C .....degrees Celcius
cDCE.....cis-1,2-dichloroethene
CERCLIS .....Comprehensive Environmental Response, Compensation, and Liability Information System
COC .....contaminant of concern
CSIA .....compound specific isotope analysis
CSM.....conceptual site model
Dhc.....*dehalococcoides*
DO.....dissolved oxygen
EA .....environmental assessment
EPA.....Environmental Protection Agency
FS .....feasibility study
GC-IRMS.....gas chromatography-isotope ratio mass spectrometry
GRO .....gasoline-range organics
HCl.....hydrochloric acid
HDPE .....high density polyethylene
HNO_3.....nitric acid
H_2SO_4.....sulfuric acid
IDW.....investigation-derived waste
µg/L.....microgram per liter
mL .....milliliter
ML&P .....Municipal Light and Power
MNA .....monitored natural attenuation
ORP.....oxygen reduction potential
PCE .....tetrachloroethene
PE.....professional engineer
PPE.....personal protective equipment
PVC.....polyvinyl chloride
QEP .....qualified environmental professional
SIM .....selective ion monitoring
TCE.....trichloroethene
tDCE trans-1,2-dichloroethene
USGS .....United States Geological Survey
UST.....underground storage tank
VC.....vinyl chloride
VOA.....volatile organic analysis
VOCs.....volatile organic compounds
WP.....work plan

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1.0 INTRODUCTION

Ahtna Engineering Services, LLC (Ahtna) has developed this Work Plan (WP) on behalf of the Alaska Department of Environmental Conservation (ADEC) to conduct a focused groundwater characterization at the Alaska Real Estate Parking Lot in Anchorage, Alaska. The groundwater characterization will support a focused feasibility study (FS) under Notice to Proceed Number 18-8036-01-008. The activities detailed in this WP are to be conducted in accordance with ADEC 18 Alaska Administrative Code (AAC) 75 *Oil and Other Hazardous Substances Pollution Control,* dated April 8, 2012; and *Monitoring Well Guidance* dated September 2013. This WP describes drilling, sampling, handling, and analytical procedures that will be used during field activities at the site.

1.1 Project Objectives

The objectives of this project are the following:

- Assess the status of the tetrachloroethylene (PCE) plume at the site;
- Characterize the downgradient portion of the PCE plume north and east of the former Alaska Native Hospital property to aid in delineating the Alaska Real Estate Parking Lot plume from other downgradient plumes; and
- Conduct a focused FS to identify the preferred remedial option for the groundwater PCE plume.

1.2 Scope of Work

Ahtna will execute the following tasks to meet the project objectives:

- Install and develop two monitoring wells along Ingra Street in the public right-of-way.
- Sample thirteen monitoring wells for water quality parameters and volatile organic compounds (VOCs).
- Sample five monitoring wells for geochemical parameters indicative of monitored natural attenuation (MNA).
- Sample four monitoring wells for compound specific stable isotope analysis (CSIA).
- Sample three monitoring wells for the *Dehalococcoides* (Dhc) microorganism.
- Report field observations, findings, analytical results, and conclusions.
- Evaluate and report remedial options for the groundwater PCE plume.

1.3 Project Schedule

The project schedule for 2014 work at the Alaska Real Estate Parking Lot site is presented in Table 1-1 Ahtna will advise ADEC if circumstances arise that require schedule adjustment.

The draft characterization report will be submitted to ADEC by August 29, 2014. The draft FS report will be submitted by September 15, 2014.

TABLE 1-1: PROJECT SCHEDULE

Event	Anticipated Completion
Notice-to-Proceed	February 19, 2014
Kick-off Meeting	February 27, 2014
Draft Work Plan	March 24, 2014
Final Work Plan	April 11, 2014
Fieldwork	Mid-late April 2014
Datalogger Retrieval	August 2014
Draft Characterization Report	August 29, 2014
Draft Feasibility Study Report	September 15, 2014
Final Characterization Report	September 26, 2014
Final Feasibility Study Report	October 10, 2014
All Work Complete	December 31, 2014

1.4 Contractor Personnel

This project will be managed by Olga Stewart and fieldwork executed by Olga Stewart, Joel Brann, and other Ahtna support staff. Geosyntec staff will assist in the analysis and review of collected data. The project team will consist of the Ahtna staff, or alternate qualified staff, and subcontractor personnel listed below.

- Olga Stewart, PE, Ahtna Project Manager, Site Safety and Health Officer
  907-865-3865 Office
  (b) (6) Cell

- Alex Geilich, Field Team Member
  907-433-0728 Office
  (b) (6) Cell

- Ben Martich, QEP, Geosyntec Senior Scientist
  907-433-0770 Office
  (b) (6) Cell

- Ryan Wymore, PE, Geosyntec Technical Lead
  303-790-1340 Office
  (b) (6) Cell

1.5 Subcontractors

- Travis Drewry/Glen Roth, GeoTek Alaska, Inc.
  GeoTek will provide drilling and monitoring well installation services.
  Anchorage, Alaska
  907-569-5900 Office

- Karl Hornyik, OnSite Environmental
  OnSite will provide VOC and MNA analytical services for groundwater samples.
  Redmond, Washington
  425-883-3881 Office

- Robbin Robl, Microseeps
  Microseeps will provide CSIA analytical services for groundwater samples.
  Pittsburgh, Pennsylvania
  412-826-5245 Office

- Jeff Roberts, SiREM
  SiREM will provide Dhc analytical services for groundwater samples.
  Geulph, Ontario, Canada
  519-515-0852 Office
  (b) (6) Cell

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2.0 SITE DESCRIPTION AND BACKGROUND

The Alaska Real Estate Parking Lot site is located at the northeast corner of 4th Avenue and Gambell Street in Anchorage, Alaska, approximately 1.3 miles east of Cook Inlet's Knik Arm (Figure 1). The approximate location is latitude 61° 13'17.81" north and longitude -149° 52'11.95" west within Section 18, Township 13 North, and Range 3 West of the Seward Meridian.

The site is undeveloped and used as a gravel-surfaced parking lot with one communication tower/antennae used by Alaska Communication on the southeast corner. The property includes four tax lots (8A, 10, 11, 12) on Block 26A of the East Addition to the Townsite of Anchorage (Figure 2), encompassing approximately 40,600 square feet of land (E&E, 2013). The property is owned by The Fourth and Gambell, LLC organization.

Three structures were previously located on the property: a dry cleaner in one building on the west side of the property from 1968-1970 and a tire center/automotive shop located in two buildings on the eastern side of the property from 1976-1978 (E&E, 2013). Contamination found at the site includes VOCs typically associated with dry cleaning, including PCE, and one of its breakdown products trichloroethylene (TCE). Three other breakdown products cis-1,2-dichloroethylene (cDCE), trans-1,2-dichloroethylene (tDCE), and vinyl chloride (VC) have not been detected at the site but have been detected downgradient.

The property is generally flat at approximately 110 feet above mean sea level. The surrounding area has a gentle slope to the north towards the Ship Creek drainage at which point a steep drop-off in elevation occurs. To the north of the site are residential buildings including single- and multi-family dwellings. Further north is the former location of the Alaska Native Hospital.

This site has also been investigated by the Environmental Protection Agency (EPA). For the EPA program, the site is known as "Fourth and Gambell Parking Lot" and identified by Comprehensive Environmental Response, Compensation, and Liability Information System (CERCLIS) identification number AKN001002925.

2.1 Previous Investigations

The following environmental investigations have occurred at the site. These are described in Table 2-1.

TABLE 2-1: PREVIOUS INVESTIGATIONS

Date	Contractor	Summary of Work
1993	EnviroAmerica, Inc.	An environmental assessment (EA) documented possible underground storage tanks (USTs).
1997	Environmental Project Management, Inc.	An initial site characterization and subsurface investigation was completed. Three monitoring wells were installed (EPM-1, EPM-2, EPM-3). Test pits were dug that showed 3 USTs (2 heating oil, 1 hydraulic fluid) and 7 hydraulic hoists. A wood crib and associated sumps were found for discharge of rinse and wash water. Also found a log crib and drums near the former dry cleaner.

Date	Contractor	Summary of Work
2004	Braunstein Geological and Environmental Services	A phase II environmental site assessment was conducted including removal of 5 hydraulic lifts, 4 USTs. Samples showed gasoline-range organics (GRO) and PCE in soil and PCE in EPM-1/MW-1.
2005	Braunstein Geological and Environmental Services	A soil and groundwater assessment was conducted with three borings completed as monitoring wells (MW-2, MW-3, MW-4). PCE was detected in both soil and groundwater.
2007	Braunstein Geological and Environmental Services	An additional site assessment included five soil borings and three monitoring wells (MW-5, MW-6, MW-7). PCE was detected in both soil and groundwater.
2008	OASIS Environmental, Inc.	A site characterization report was drafted to determine the nature and extent of contamination related to the site. Six borings were drilled and temporary monitoring wells sampled from those borings. PCE was detected in soil and groundwater with the exception of SB-1 which was located upgradient.
2008	CH2M Hill and Ecology and Environment	In coordination with the nearby Anchorage Terminal Reserve contaminated site, 26 groundwater samples were collected from temporary well points. Groundwater was found to flow north-northwest and was detected as far as 0.4 miles downgradient, where the sources become unclear as another plume from the east may intermingle.
2009	OASIS Environmental, Inc.	A vapor intrusion study was conducted with indoor air, outdoor air, and soil gas samples. PCE was detected in all media, with some presence of TCE.
2011	Ecology and Environment	An EPA preliminary assessment was conducted to evaluate receptors.
2012	OASIS Environmental, Inc.	Additional characterization was completed with installation of four wells (MW-8, WM-9, MW-10, MW-11) east of the site. The wells were not impacted with PCE greater than cleanup levels and soil gas samples in the same area were not impacted.
2013	Ecology and Environment	An EPA site inspection was conducted to evaluate the potential for listing on the National Priorities list. Potential sources and receptors were identified. Investigation of all media were conducted: indoor air, outdoor air, soil gas, surface soil, subsurface soil, groundwater, and sediment. Eleven borings were drilled and temporary monitoring wells sampled from those borings. PCE was detected in all media except sediment.

2.1.1 Nearby Contaminated Sites

The Alaska Railroad Corporation (ARRC) Anchorage Terminal Reserve is a large (600 acres) property with contaminated soil and groundwater. The Area GW 2/3 is located south of Ship Creek, along Ship Creek Avenue and west of Ingra Street. Vinyl chloride has been identified at this site (CH2M Hill, 2008). The ARRC has completed characterization work in the vicinity of the downgradient portion of the Alaska Real Estate Parking Lot plume. The geology has been extensively mapped in the area adjacent to Ship Creek and tidal influence has been studied with datalogging pressure transducers.

As part of the ARRC investigation for the source of vinyl chloride at Area GW2/3, a review of nearby contaminated sites was performed. The Municipal Light and Power (ML&P) Fleet

Services Maintenance Facility, offices and warehouse, and storage building were all identified to the north and east of the Alaska Real Estate Parking Lot site. The Anchorage Cold Storage/Odom facility was identified further east, beyond Post Road.

Additionally, an undeveloped lot to the north and east of the Alaska Real Estate Parking Lot site was evaluated in 2007 for proposed construction of a hazardous waste treatment facility (E&E, 2007).

2.1.2 Existing Monitoring Wells

Many monitoring wells exist at the project site and downgradient of the site. Monitoring wells MW-1 through MW-7 are located on site within the groundwater PCE plume. Monitoring wells MW-8 through MW-11 are located to the east of the former tire center and bound the plume to the east. These wells are shown on Figure 3.

Due to the proximity of other contaminated sites in the area, additional monitoring wells are located downgradient of the site that are associated with other sites and may be used to bound the Alaska Real Estate Parking Lot plume. Monitoring wells in place at nearby sites that may aid in defining the plume are shown on Figure 3.

MW28, an ML&P well, is located downgradient and within the plume and is incorporated into this plan.

2.2 Groundwater Plume Data Gaps

The groundwater plumes have not been fully characterized laterally or vertically at the Alaska Real Estate Parking Lot site. Figure 3 shows the current understanding of the lateral extents of the plumes. Uncertainty exists as to the origin of the contaminants in the vicinity of Ingra Street and North Ingra Street.

2.3 Conceptual Site Model

A conceptual site model (CSM) was prepared as part of the Site Characterization Report prepared by OASIS Environmental, Inc. in 2008 and updated in 2012. Based on the Site Inspection report from February 2013, an updated CSM is provided in the following sections, focusing on the groundwater media (E&E, 2013).

2.3.1 Sources

Potential sources are described in detail in the February 2013 Site Inspection report (E&E, 2013). The sources include a wood crib and associated underground collection sumps located near the former NC Tire Center property, a log crib located near the former C and K Cleaners property, and four buried drums marked for dry cleaning use near the former C and K Cleaners property. Petroleum USTs and hoists were also located in the area but have been removed and no evidence of petroleum impacts remains. A secondary source of contamination appears to be PCE-impacted soil in the subsurface at the site.

2.3.2 Contaminants of Potential Concern

Contaminants of concern (COCs) are based on historic groundwater sampling in the area are VOCs, specifically PCE and TCE. Daughter products cDCE, tDCE, and VC and other VOCs have been found in select areas downgradient.

2.3.3 Potential Migration Pathways

Impacted groundwater has migrated to the northeast and north from the site toward Ship Creek in the upper aquifer that is confined by the Bootlegger Cove clay formation at approximately 50 feet below ground surface. From groundwater, volatile contamination is likely volatilizing to air (as evidence by air impacts). Sediment samples indicate that there are no impacts from groundwater to the sediment. VOCs are not typically taken up by biota and so uptake by plants or animals is unlikely. There is a data gap as to whether the impacted groundwater is flowing to the Ship Creek surface water body.

2.3.4 Potential Exposure Routes

The area of the groundwater plume is located within the municipal drinking water system, and it appears that no private drinking water wells are located in the area (E&E, 2013). Surface water from Ship Creek is not used as a resource, for recreation, or for drinking water (E&E, 2013).

2.3.5 Potential Receptors

Due to the lack of exposure routes, it is not likely there are any receptors to impacted groundwater.

2.4 Regulatory Framework

A regulatory framework for this project has been developed by consideration of the following regulations and guidance documents.

- 18 Alaska Administrative Code (AAC) 75, Oil and Other Hazardous Substances Pollution Control, April 8, 2012.
- Policy Guidance on Developing Conceptual Site Models, ADEC Division of Spill Prevention and Response, Contaminated Sites Program, October 2010.
- Site Characterization Work Plan and Reporting Guidance for Investigation of Contaminated Sites, DEC Division of Spill Prevention and Response, Contaminated Sites Program, September 23, 2009.
- *Draft* Field Sampling Guidance, DEC Division of Spill Prevention and Response, Contaminated Sites Program, May 2010.
- Monitoring Well Guidance, DEC Division of Spill Prevention and Response, Contaminated Sites Program, September 2013.
- Environmental Molecular Diagnostics, ITRC web-based guidance document, *http://www.itrcweb.org/emd-2/*.

Groundwater analytical data will be compared to Table C groundwater cleanup levels in Table C of 18 AAC 75.345. Table 2-2 lists the cleanup levels for the COCs.

TABLE 2-2: GROUNDWATER CLEANUP LEVELS

Contaminant	Cleanup Level (µg/L)
PCE	5
TCE	5
cDCE	70
tDCE	100
VC	2

Key:
PCE tetrachloroethylene
TCE trichloroethylene
cDCE cis-1,2-dichloroethylene
tDCE trans-1,2-dichloroethylene
VC vinyl chloride
µg/L micrograms per liter

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3.0 FIELD ACTIVITIES

Field activities for this project are anticipated to be conducted in mid to late April 2014. The field tasks are listed and described, and methods are explained, in the following sections. All fieldwork and all field and laboratory quality assurance criteria for this project will be conducted in accordance with applicable ADEC procedures. Fieldwork will be conducted by Olga Stewart and Joel Brann, both qualified field scientists as defined in 18 AAC 75.990(100).

The field activities will occur in the following order.

1. Stake out the locations of the two new monitoring wells.
2. Ensure access/permits to the locations and utility locates are complete.
3. Drill the soil borings and install the two new monitoring wells.
4. Develop the monitoring wells.
5. Sample the new and existing monitoring wells according to the proposed plan.
6. Package and transfer samples to the laboratory.
7. Package and dispose of investigation-derived waste.
8. Deploy datalogging pressure transducers.
9. Retrieve datalogging pressure transducers after approximately five months.

3.1 Monitoring Well Locations and Utility Locates

Based on the current understanding of the groundwater plume of PCE, two new monitoring wells will be placed downgradient of the site to further delineate the plumes. These wells will aid in determining whether the plume deviates toward the north or west from its trajectory and/or whether the plume intersects another plume near Ship Creek. The anticipated locations of the monitoring wells are shown on Figure 3. These locations will be staked out and rights of access confirmed prior to drilling. The Alaska Dig Line will be contacted following stake-out to conduct a utility locate in the area. Once access and utility locates are complete, drilling will commence.

Naming of wells in this area is difficult due to the abundance of wells placed by many contractors for many sites over many years. In order to maintain the numbering scheme of the Alaska Real Estate Parking Lot Site, the wells will be named MW-12 and MW-13, but with the prefix “4G” to indicate that the wells are related to the Fourth and Gambell site. The well names will be 4GMW-12 and 4GMW-13.

3.2 Drilling and Soil Screening

The new monitoring wells will be installed using a Geoprobe direct-push drilling rig with a method for continuous soil recovery below the water table. Recovered soil will be screened using the Color-Tec® method three-foot intervals beginning at the top of the water table. The Color-Tec® method is as follows:

A dedicated sample spoon will be used to place approximately 30 grams of soil from the chosen sample core into two unpreserved 40 mL vials. Deionized water will be added to the vials until they are 70% full. The vials will be heated to approximately 100 °F in a hot water bath.

Color-Tec® analysis will be performed as described in the method in Appendix A. Screening data will be recorded on boring logs shown in Appendix B.

Screening samples will be collected until the most impacted zone of groundwater is identified. The screened interval of the well will be set at this location/depth.

3.3 Monitoring Well Installation and Development

Both groundwater monitoring wells will be constructed of 2-inch-diameter, Schedule 40 poly-vinyl chloride (PVC) casing with a 5-foot-long, 0.010-inch slotted-screened interval centered on the most impacted zone identified during screening. The groundwater monitoring wells will contain a filter pack of Colorado 10-20 sand around the screen and at least 2 feet above the screen. A bentonite seal will be placed above the sand (at least 6-inches thick), with a second sand/native fill layer at the ground surface. The bentonite material will be hydrated as part of the sealing process. The groundwater monitoring wells will be completed as flush mount due to the proximity to roadways, parking lots, and plowing. The flush monuments will be set in concrete. Groundwater monitoring well completion details will be recorded on monitoring well installation forms found in Appendix B.

Following completion, 24-hours will be allowed to pass until the wells are developed. All groundwater monitoring wells will be developed prior to sample collection. The goal of well development is to ensure proper hydraulic connection to the surrounding aquifer allowing for free flow of formation water into the well for sampling. Well development is the agitation of the adjacent formation and pulling of the fines into the well. Well development consists of repeatedly surging the well with a surge block followed by purging of groundwater. Well development (surging and purging) will continue until ten well casing volumes have been removed and the water contains substantially less sediment.

3.4 Groundwater Monitoring

Following development of the new monitoring wells, once groundwater has stabilized in the formation, groundwater will be sampled.

3.4.1 Groundwater Purging

Thirteen wells will be sampled using low-flow purge and sample techniques with a bladder pump. The wells to be sampled are summarized in Table 3-1.

TABLE 3-1: WELLS TO BE SAMPLED

Well ID	Well Owner	Well Location
MW-11	Fourth and Gambell	Background
MW-1	Fourth and Gambell	Source Area
MW-3	Fourth and Gambell	Source Area
MW-6	Fourth and Gambell	Source Area
4GMW-12	Fourth and Gambell	Mid-plume
4GMW-13	Fourth and Gambell	Mid-plume
MW-1	PENCO	Mid-plume
MW-28	ML&P	Mid-plume

Well ID	Well Owner	Well Location
MW12S	ML&P	Downgradient transect
MW-13	ML&P	Downgradient transect
DPB24	ARRC Terminal Reserve	Downgradient transect
MWB09-D3	ARRC Terminal Reserve	Downgradient transect
MWB09-E1	ARRC Terminal Reserve	Downgradient transect

Care will be taken to minimize drawdown by routinely monitoring the depth to groundwater. The low-flow purge and sample collection technique involves purging the well at flow rates of 0.1 to 0.5 liters per minute using a stop-watch and a one liter graduated cylinder. Once a flow rate is established the field team will repeatedly measure the depth to water during purging to ensure that minimal drawdown (less than 0.3 feet) is occurring in the well. If drawdown occurs at more than 0.3 feet while purging, the flow rate will be decreased until the recharge is equivalent to the discharge. A water quality meter with flow-through cell will then be connected to the bladder pump discharge line and water quality measurements will be recorded every three to five minutes. During purging, water quality parameters will be monitored until four of the five below parameters are stable based on the following criteria:

- pH is stable within 0.1 pH units;
- Temperature is stable within 0.2 degrees Celsius (°C);
- Conductivity is stable within 3 percent (%);
- Oxidation-reduction potential (ORP) is stable within 10 millivolts; or
- Dissolved oxygen (DO) is stable within 10%.

All measurements, including depth to water and the parameters listed above, will be recorded on groundwater sample data sheets provided in Appendix B.

If stability of the above parameters cannot be achieved, then removal of three casing volumes will be performed at which time sampling will commence. The removal of three volumes is not necessary if stability is achieved sooner during the purge process, as evidenced by successive parameter readings that are within the stated tolerances.

Groundwater samples will be collected within the mid-point of the screened interval, if known. If a well is low yield and purges dry, a sample will not be collected until 80% recharge is measured. When returning to collect a sample from a low-yield well, no additional purging will be conducted; the sample will be immediately collected.

3.4.2 Groundwater Sampling

Once purging is complete, and the water quality meter is disconnected, groundwater samples will be collected. Each water sample volume for VOC analysis will be placed into 40-milliliter (ml) vials pre-preserved with hydrochloric acid (HCl). The sample bottles for VOCs must be filled slowly to prevent the entrapment of air bubbles, splashing, or agitation of the water. The bottle will be filled completely such that a positive meniscus forms. The cap will then be secured and the bottle inverted, tapped firmly, and checked for the presence of air bubbles. Accurate analytical results for volatiles may be compromised if there is any free air trapped in the sample container.

All groundwater samples will be analyzed for VOCs. Samples from MW-1, MW-6, MW-11, MW-28, and the new well at the west corner of Ingra Street and First Avenue will be analyzed for key parameters indicative of natural attenuation including the following:

- total organic carbon,
- dissolved gases (ethane / ethene / methane),
- ferrous iron, and
- anions for nitrate and sulfate.

In addition, samples from monitoring wells MW-1 (Fourth and Gambell, not PENCO), MW-6, and the new well near the west corner of Ingra Street and First Avenue will be analyzed for CSIA and the *Dhc* microorganism. The sampling procedure for *Dhc* is described in Appendix C. Groundwater from MW-28 will also be analyzed for CSIA. Table 3-2 shows a summary of groundwater samples to be collected.

TABLE 3-2: SUMMARY OF GROUNDWATER SAMPLES TO BE COLLECTED

Well	VOCs	MNA	CSIA	Dhc
MW-11	X	X		
MW-1 (4G)	X	X	X	X
MW-3	X			
MW-6	X	X	X	X
4GMW-12 (Ingra & 2nd)	X			
4GMW-13 (Ingra & 1st)	X	X	X	X
MW-1 (PENCO)	X			
MW-28 (ML&P)		X	X	
MW-28	X			
MW12S	X			
MW-13	X			
DPB24	X			
MWB09-D3	X			
MWB09-E1	X			

CSIA is an environmental molecular diagnostic tool that can identify differences in isotopic ratios of contaminants to determine whether the contaminant detected in one well is from the same source or release as another well. CSIA will assist in determining whether the presence of PCE and TCE in Ship Creek Basin are in fact related to the Alaska Real Estate Parking Lot site, or whether there are other sources in the Ship Creek Basin contributing to the contaminant mass in groundwater. Samples will be analyzed for carbon and chlorine isotopes ($^{13}C/^{12}C$ and $^{37}Cl/^{35}Cl$) of PCE and TCE.

3.5 Continuous Groundwater Elevation Measurements

Following sampling, data logging pressure transducers will be deployed in three wells located in Ship Creek Basin to measure groundwater fluctuation and flow direction variability. The three wells will be DPB24, which is owned by ARRC, MW12S, which is owned by ML&P, and the new well to be installed near the west corner of Ingra Street and First Avenue (4GMW-13).

These wells were chosen as they are situated in a pattern that will allow triangulation of groundwater flow direction and gradient in Ship Creek Basin at the presumed leading edge of the plume. The dataloggers will record groundwater elevations every hour on the hour. One barometric pressure logger (barologger) will also be deployed in well MW12S to record pressure fluctuations at the site.

The three wells that have dataloggers deployed will be surveyed for elevation to ensure accurate datalogger measurements. The dataloggers will be deployed on a steel wire to a depth that will be continuously submerged in groundwater. The logger will be lowered into the well to a specified depth and secured to the underside of the well cap. The well cap will be put in place but left loose in order to maintain atmospheric pressure within the well. The water level will be manually measured using an electronic water level meter within 15 minutes of the automatic logger reading.

Surface water elevation and discharge rate in Ship Creek will also be monitored at United States Geologic Survey (USGS) gauge 15276000, located upgradient of the site near Moose Run golf course. This data, combined with groundwater elevation data, will allow for hydrogeological analysis for a period from April to August 2014.

The dataloggers and barologger will be retrieved from the three wells in August 2014. Prior to retrieval, the water level will be manually measured using an electronic water level meter within 15 minutes of the automatic logger reading. The loggers will then be retrieved and the data downloaded to a computer for analysis.

3.6 Monitoring Well Survey

Following well installation, the location and top-of-casing (measuring point) elevations of the three wells in which dataloggers will be placed will be surveyed. The top of casing (at the mark) as well as the ground surface elevation immediately adjacent to the groundwater monitoring well monument will both be surveyed. The surveyor responsible for the survey data will certify that the survey loop is closed to within an accuracy of 0.2 feet for horizontal coordinates and 0.01 feet for elevation. Raw survey data will be included in the subsequent report.

3.7 Decontamination

When possible, disposable sampling and personal protective equipment (PPE) will be used for field activities; however, some of the sampling equipment will be non-dedicated and will require decontamination between uses. Equipment anticipated for field decontamination includes, but is not limited to the following:

- Drill rods
- Water level indicator
- Bladder pump

The decontamination procedures for the monitoring equipment will consist of the following activities:

- Scrub with brushes using an Alconox solution,
- Rinse with distilled water,
- Dry with paper towel, and
- Air dry.

Drill rods will be decontaminated by the drilling subcontractor using a decontamination pool to contain investigation-derived waste (IDW).

3.8 Waste Management

IDW anticipated to be generated during the field event includes the following:

- Excess soil cuttings from drilling monitoring wells,
- Development and purge water from monitoring wells,
- Spent tubes from Color-Tec® field tests,
- Used disposable sampling equipment, and
- Used PPE.

Soil cuttings are anticipated to be non-hazardous waste. Cuttings will be placed in a locking steel drum, labeled "Non-Hazardous Waste" with contact information for Ahtna .One soil sample will be collected from the drummed cuttings and analyzed for VOCs by EPA Method 8260 to determine disposal options. Soil will be disposed by Emerald Alaska.

Decontamination and purge water generated from sampling and sampling materials, PPE, and spent tubes from Color-Tec® field tests that have been in contact with the PCE-impacted groundwater are anticipated to be F-listed waste (F002) for PCE. The ADEC Department of Spill Prevention and Response is a Conditionally Exempt Generator with facility ID AKR000200790. The water and materials will be segregated and each placed in a locking steel drum and labeled "Hazardous Waste," the accumulation start date, i.e. the date when waste is first added to each container. Container marking will also include a waste description and contact information. The drums will be picked up by Emerald Alaska at the end of the day to prevent having to store the drums on site. Emerald Alaska will manifest and the drums at an approved facility within 270 days.

4.0 QUALITY ASSURANCE / QUALITY CONTROL

4.1 Field Procedures

All fieldwork and laboratory analyses will be conducted in accordance with 18 AAC 75, 18 AAC 78, and the associated guidance manuals. Field personnel will collect samples in a manner that preserves the integrity of the sample matrix. Samplers will use dedicated PPE to prevent cross-contamination between samples. Sampling supplies will be dedicated to each sample location. Sample matrices will have minimal disturbance prior to collection. Sample containers will be sealed, labeled, and placed on gel ice immediately following collection.

4.2 Field Documentation

All equipment will be calibrated, maintained and operated according to manufacturer recommendations. Field documentation will consist of the use of a field notebook, sample identification labels, and photographs. A written record of all field activities will be kept in a field logbook. All entries will be legible, written in waterproof ink, and contain accurate and inclusive documentation of the field activities. Errors or changes will be noted using a single line to cross out the entry and will be dated and initialed. The logbook will be maintained as part of the permanent record for the site. All field logbook entries will be dated and signed. Activities and observations to be noted in the logbook include the following:

- Name of author and date and time of entry
- Names and affiliations of personnel on-site
- Location of activity and site conditions
- Field observations and comments
- Documentation of instrument calibration
- Weather conditions
- Rationale for sampling locations and for any changes to sampling protocol
- Locations of site photographs
- Site sketches
- Health and safety comments

4.3 Sample Handling and Labeling

Samples will be numbered using the following format:

14-AREPL-MW01-GW

where “14” represents the year; “AREPL” represents “Alaska Real Estate Parking Lot”; “MW01” is the well identifier/name; and “GW” is the designator for sample type. Possible sample types include GW for groundwater and TB for trip blank.

Samples will be tracked by use of chain-of-custody laboratory forms. Each sample will be individually identified on a chain-of-custody form. These forms will include sample identification number, sample date, sample time, requested analysis, type and number of sample

containers, sample preservatives, quality control information, and requested analytical turnaround time. The chain of custody record must accompany the coolers in which the samples are packed. When transferring samples, the individuals relinquishing and receiving the coolers must sign, date, and note the time on the chain of custody record. This record documents sample custody transfer. Sample coolers will be shipped via Alaska Airlines to Washington and via Federal Express to Pennsylvania and Ontario.

4.4 Analytical Program

Groundwater samples collected for analysis will be submitted to the ADEC-approved laboratory OnSite Environmental located in Redmond, Washington for groundwater analytical services, with the exception of CSIA and *Dhc*. Microseeps of Pittsburgh, Pennsylvania, will perform CSIA for $^{13}C/^{12}C$, and Microseeps will subcontract with the University of Oklahoma for $^{37}Cl/^{35}Cl$. SiREM of Geulph, Ontario will perform analysis for *Dhc*. Laboratory analysis methods to be used for groundwater samples during this project are presented in Table 4-1.

TABLE 4-1: SAMPLE ANALYSIS METHODS

Parameter	Analytical Method	Sample Container	Preservation	Holding Time
COCs				
PCE, TCE, cDCE, tDCE, 1,1-DCE, VC	EPA 8260C SIM	(3) 40-mL VOA vials	HCl Chill to 4°C	14 days
MNA				
Total Organic Carbon	SM 5310B	250-mL HDPE	HCl Chill to 4°C	28 days
Nitrate/nitrite	EPA 353.2	250-mL HDPE	H_2SO_4 Chill to 4°C	28 days
Sulfate	ASTM D516-07	250-mL HDPE	Chill to 4°C	28 days
Total Iron	EPA 6010	250-mL HDPE	HNO_3 Chill to 4°C	180 days
Dissolved Iron	EPA 6010	250-mL HDPE	Field filtered & HNO_3 Chill to 4°C	180 days
Methane/ethane/ethene	AM20GAX	(2) 40-mL VOA vials	HCl Chill to 4°C	180 days
CSIA				
Carbon for PCE and TCE	GC-IRMS	(9) 40-mL VOA vials	HCl Chill to 4°C	14 days
Chlorine for PCE and TCE	GC-IRMS	(8) 40-mL VOA vials	H_2SO_4 Chill to 4°C	14 days
Dhc				
Gene-Trac®-Dhc	US Patent No 8,063,192	(2) 50-mL filter containers	Field filtered Chill to 4°C	10 days

Key:
ASTM = American Society of Testing and Materials
GC = gas chromatography
HCl = hydrochloric acid
HDPE = high density polyethylene
HNO_3 = nitric acid
H_2SO_4 = sulfuric acid
IRMS = isotope ratio mass spectrometry
mL = milliliter
SIM = selective ion monitoring
VOA = volatile organic analysis

4.5 Field Quality Control

Field quality control samples will be collected to assess potential errors introduced during sample collection, handling, and analyses. The field quality control samples are identified in Table 4-2. No duplicates will be analyzed for the MNA parameters, CSIA, or *Dhc* samples.

TABLE 4-2: FIELD QUALITY CONTROL SAMPLES

Sample Name	Media	Analysis Method	Frequency
Field Duplicate	Water	EPA 8260	1 per 10 samples (10%) for each analytical method
Trip Blank	Water	EPA 8260	1 per sample cooler containing VOC samples
Temperature Blank	40 mL vial of tap water	--	1 per sample cooler

The allowable tolerance for field duplicates is a relative percent difference of 30% for water samples. Laboratory quality control samples shall include method blanks, laboratory control samples, and matrix spike/matrix spike duplicates.

Laboratory performance and analytical results will be checked through a quality assurance review, which will include ADEC's Laboratory Data Review Checklist. The review will assess analytical quality through six data quality indicators: completeness, accuracy, precision, comparability, representativeness, and sensitivity.

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5.0 REPORTING

Ahtna will provide two reports to ADEC in accordance with the RFP: an FS report and a characterization report. The draft characterization report will be submitted to ADEC by August 29, 2014. The draft FS report will be submitted by September 15, 2014.

5.1 Characterization Report

After receipt of final laboratory results for the fieldwork event, and retrieval of datalogging pressure transducers, Ahtna will prepare a draft characterization report. The report will include the following items:

- Introduction and background with details for project objectives, scope of work, and regulatory framework;
- Description of field activities to execute the scope of work and meet project objectives, including management of IDW and any deviations from the work plan;
- Presentation of data and findings in narrative, tables, and figures;
- Written quality assurance review of field and analytical protocols and ADEC Laboratory Data Review Checklists;
- Interpretation and evaluation of the PCE plume, groundwater dynamics, and CSIA and *Dhc* data;
- Updated conceptual site model;
- Conclusions and proposed recommendations;
- Appendices will include analytical data reports and chains-of-custodies, field notes, imagery, the survey report, waste manifests, and conceptual site model forms

Ahtna will submit an electronic version of the draft report to ADEC in MS Word format. Following receipt of comments from ADEC, Ahtna will finalize the report and submit one hardcopy and two electronic copies on clearly labeled CDs. The electronic copies will contain a complete Adobe PDF version and individual MS Word and Excel files.

5.2 Feasibility Study

In conjunction with and following the characterization report, Ahtna will prepare a focused FS that evaluates the five remedial alternatives presented in the 2013 draft FS. For each alternative, the FS report will include a conceptual layout, estimates of equipment and materials required, proposed monitoring/injection well locations, required monitoring, institution controls, and operational timeframes. This FS will only cover groundwater contamination, and each alternative will be configured in a way that mitigates further downgradient migration of groundwater contamination. Each alternative will be evaluated against the standard CERCLA threshold, balancing and modifying criteria, and a comparative analysis of the alternatives will be presented. In addition, the FS report will present a detailed cost estimate for each alternative, as well as a detailed cost comparison between all five alternatives.

Ahtna will submit an electronic version of the draft report to ADEC in MS Word format. Following receipt of comments from ADEC, Ahtna will finalize the report and submit one

hardcopy and two electronic copies on clearly labeled CDs. The electronic copies will contain a complete Adobe PDF version and individual MS Word and Excel files.

6.0 REFERENCES

CH2M HILL, 2008. *Area GW 2/3 Supplemental Groundwater Investigation in the Vicininty of the Alaska Railroad Corporation, Anchorage Terminal Reserve*, Technical Memorandum, Contract Number 68-S7-04-01, Task Order 0007. November 7.

Ecology and Environment (E&E), 2013. *Fourth Avenue and Gambell Parking Lot Site Inspection, Anchorage, Alaska*, Contract Number EP-S7-06-02, Technical Direction Document Number 12-01-0004. February.

E&E, 2007. Phase II Environmental Site Assessment, 920 First Avenue, Anchorage, Alaska, Prepared for PENCO. February.

FIGURES

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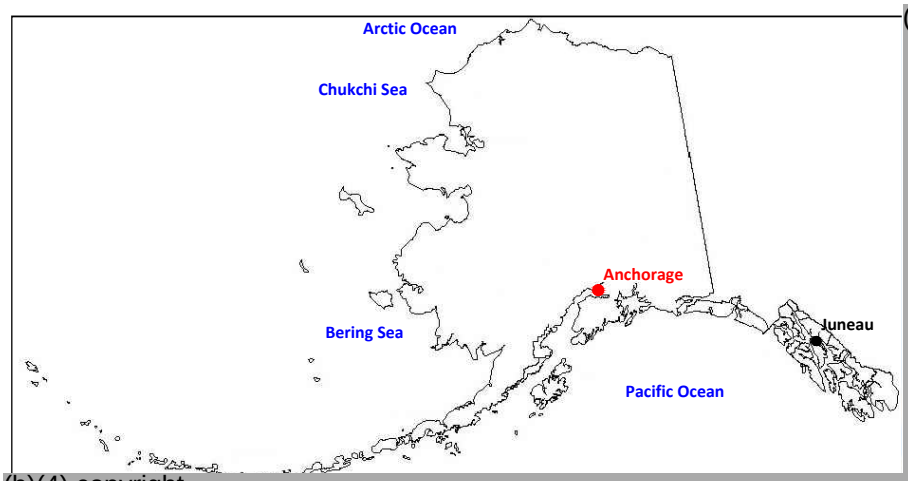

(b)(4) copyright

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1. All locations are approximate.
2. Image provided by Google Maps, Anchorage, 03.05.2014.

Focused Groundwater Characterization
Alaska Real Estate Parking Lot, Anchorage, Alaska

Ahtna Engineering

State and Site Vicinity Map

Project Number:	Figure Number:
20266.008	1
Date: 03.05.2014	
Drawn By: G.R.	

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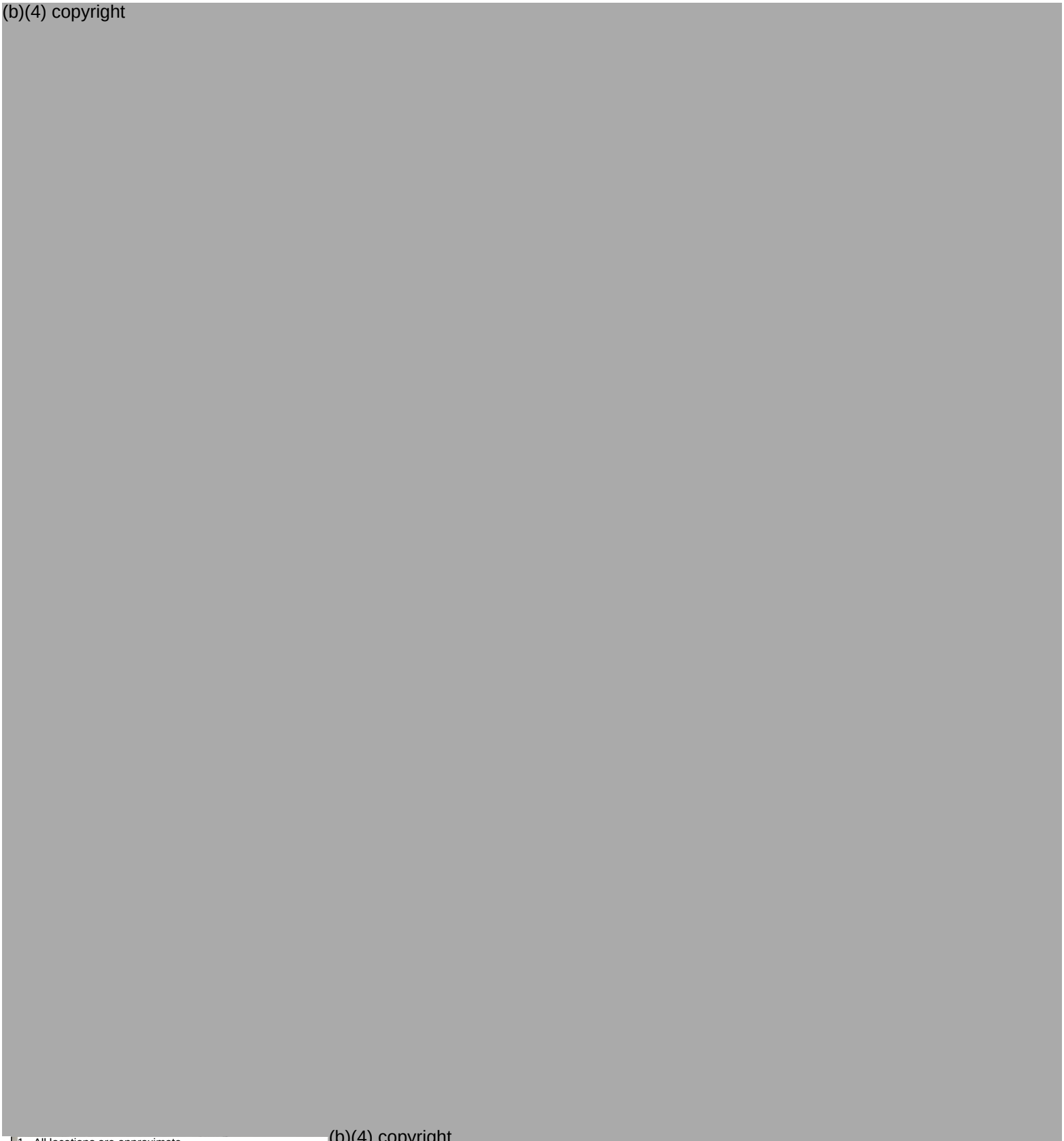

(b)(4) copyright

1. All locations are approximate.
2. Image provided by Google Maps, Anchorage, 03.05.2014.

Focused Groundwater Characterization
Alaska Real Estate Parking Lot, Anchorage, Alaska

Ahtna Engineering

Site Map

Project Number:	Figure Number:
20266.008	2
Date: 03.21.2014	
Drawn By: G.R.	

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1. All locations are approximate.
2. Image provided by Google Maps, Anchorage, 03.05.2014.
3. Monitoring wells located from figures by OASIS, E&E, RETEC, ENSR, and AECOM.

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Focused Groundwater Characterization
Alaska Real Estate Parking Lot, Anchorage, Alaska

Antna Engineering

Proposed Monitoring Well and Datalogger Locations

Project Number:	Figure Number:
20266.008	3
Date: 03.24.2014	
Drawn By: G.R.	

APPENDIX A

COLOR-TEC® METHOD PROCEDURES MANUAL

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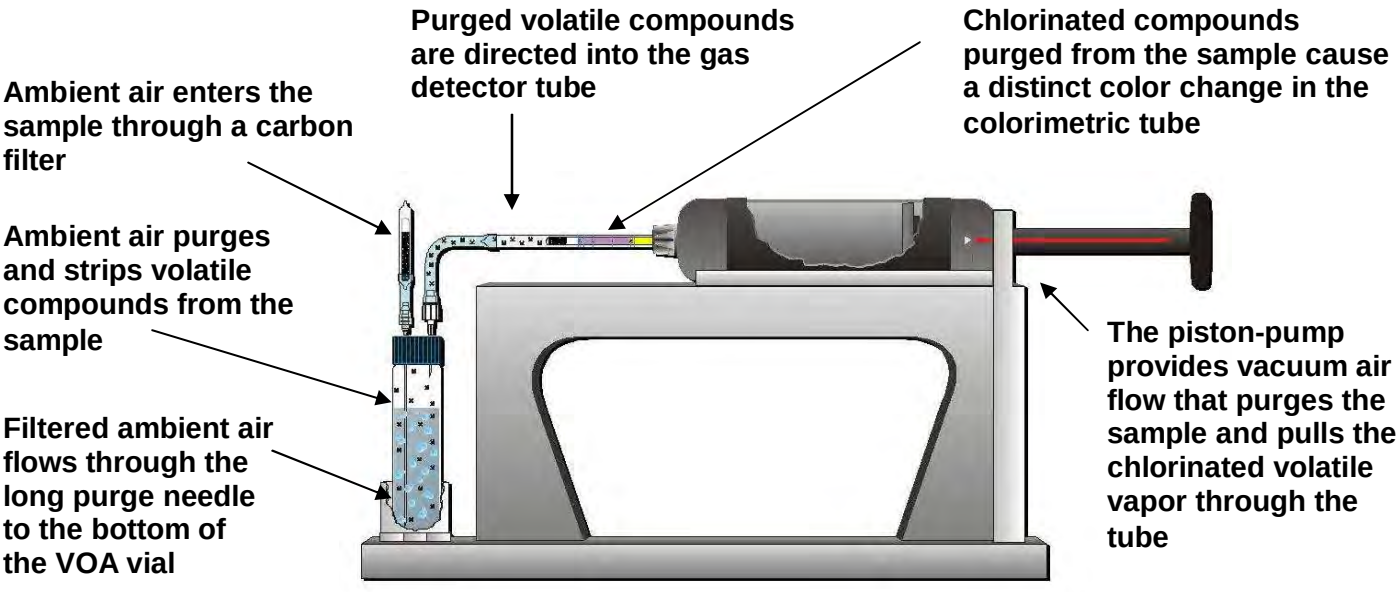
AQR Color-Tec®

Method Procedures Manual

Field-Based Analysis of Chlorinated Volatile Organic Halocarbons

- **AQR Color-Tec® combines sample purging with direct-read gas detector tubes to quickly detect low-levels of chlorinated compounds in liquid and solid samples.**
- **AQR Color-Tec® detects concentrations of total chlorinated volatile organic halocarbons (CVOHs) below 3 µg/L in water and 3 µg/Kg in soil samples.**
- **AQR Color-Tec® provides fast, low-level, economical, decision-quality data which maximizes sampling frequency and sampling coverage to locate source areas and delineate dissolved-phase contaminant plumes.**
- **Samples are analyzed by purging the volatile compounds from either liquid or solid samples through a colorimetric detector tube, which produces a distinct color change when exposed to any chlorinated compound.**



AQR Color-Tec® Contact and Ordering Information

- **For more information visit www.aqrcolortec.com**
- **For kit orders contact Phil Pecevich at 919-918-7191**
- **For training or kit orders contact Felecia Owen at 919-278-8926**
- **For training or technical support contact Perry Kelso at 850-933-2312**

Table of Contents

1.0 Method Principle

AQR Color-Tec® is a field-based analytical method which combines the use of colorimetric gas detector tubes (originally designed for occupational breathing-zone monitoring) with sample purging to detect very low (<3 µg/L or µg/Kg) concentrations of chlorinated volatile organic halocarbons (CVOHs) in liquid and solid samples. Samples are analyzed by purging the volatile compounds from a groundwater or soil sample through the colorimetric tube, which is designed to produce a distinct color change when exposed to chlorinated compounds. Estimated sample concentrations are obtained by comparing the tube readings to a conversion table based on comparing AQR Color-Tec and GC/MS split sample data.

Each colorimetric tube contains an oxidizer (PbO_2) and a catalyst (H_2SO_4) which decomposes and converts the chlorinated compounds to hydrogen chloride, which discolors a reagent (4-phenylazodiphenylamine) in the tube from yellow to purple. The reaction formula provided by Gastec® for the PCE tube is as follows:

$Cl_2C{:}CCl_2 + PbO_2 + H_2SO_4 \rightarrow HCl$
HCl + (4-Phenolazo) Diphenylamine → Chloride

The colorimetric tubes react positively to all chlorinated volatile organic halocarbons, including saturated and unsaturated chlorinated alkenes and alkanes. The total response indicated by the detector tube reflects the sum of the concentration of each individual chlorinated compound present in the sample. The method is primarily qualitative (detects the presence/absence of a compound or class of compounds).

The colorimetric gas detector tubes used in the method are designed to detect CVOHs in ambient air. Color-Tec is an alternate use of these tubes, which purges CVOHs from a water or soil sample and concentrates them into the colorimetric tube. When using colorimetric tubes for the Color-Tec method, the units (ppmV) printed on the tubes do not directly reflect the quantity of CVOHs dissolved in the water or soil sample being analyzed. The Color-Tec reading (the distance that the color change travels through the tube) is a relative response to the amount of chlorinated-compound molecules that have been purged from the sample and directed into the tube. Therefore, the units printed on the tubes are used only to record the relative response for each analysis in order to facilitate comparison of the response for comparison to laboratory GC/MS methods. The relative response (Color-Tec reading) is not the concentration in ppmv (as printed on the tubes), but rather a unit-less value which must be compared to known values in order to yield an estimate of the actual concentration present in the sample using a conversion table developed by comparison of AQR Color-Tec® tube responses to GC/MS split-sample analyses conducted on thousands of samples.

2.0 AQR Color-Tec® Test Kit Description and Set-up

The AQR Color-Tec® Chlorinated VOH Soil/Water Test Kit System consists of three primary components:

1. **Hardware Kit** - Contains reusable equipment and carrying case;
2. **20-Sample Expendables Kit** - Contains all disposable components needed for analysis of 20 water or soil samples using low range (133-LL) tubes, plus medium range (133-L) tubes and high range (133-M) tubes for re-analyzing samples that exceed the concentration range of the low range (133-LL) tubes;
3. **QA/QC Kit** – Contains components needed to perform basic QA/QC procedures to insure method performance and provide method confidence.

2.1 Materials Provided

2.1.1 AQR Color-Tec® Hardware KIT (See Figure 1)

Item	Quantity
RAE® Piston pump	1
AQR Color-Tec® Pump Stand	1
Corning® Hot Plate	1
Stainless Steel Heating Pan	1
Nalgene® VOA Heating Rack	1
Thermometer	1
Decontamination Syringe	1

2.1.2 AQR Color-Tec® 20-Sample Expendables Pack (See Figure 2)

(Analyzes 20 water or soil samples)

Item	Quantity
Low-Range (133LL) Colorimetric Detector Tubes	20
Medium-Range (133L) Colorimetric Detector Tubes	3
High-Range (133M) Colorimetric Detector Tubes	2
Extraction Needle Assemblies	25
40 Milliliter VOA Vials – empty (for samples)	40
Carbon Filter	2
Carbon Filter Luer Assembly	2
Purge Needle	2
Nitrile Safety Gloves (pair)	1

2.1.3 AQR Color-Tec® QA/QC Test Pack (See Figure 3)

(Supplies for conducting all QA/QA procedures described in Section 8)

Item	Quantity
Low-Range (133LL) Colorimetric Detector Tubes	5
Toluene colorimetric Detector Tube	1
60µg/L-TCE reference standard in flame-sealed ampoule	2
300µg/L-TCE reference standard in flame-sealed ampoule	1
600µg/L-TCE reference standard in flame-sealed ampoule	1
10 ml Pipette (for transferring standards)	4
40 ml VOA Vials (empty – (for toluene test samples)	2
40 ml VOA Vials (pre-filled with organic-free water)	4
Extraction Needle Assemblies	5
Purge Needle	1
Carbon Filter	1
Carbon Filter Luer Assembly	1
Nitrile Safety Gloves (pair)	1

Figure 1
AQR Color-Tec® Hardware Kit

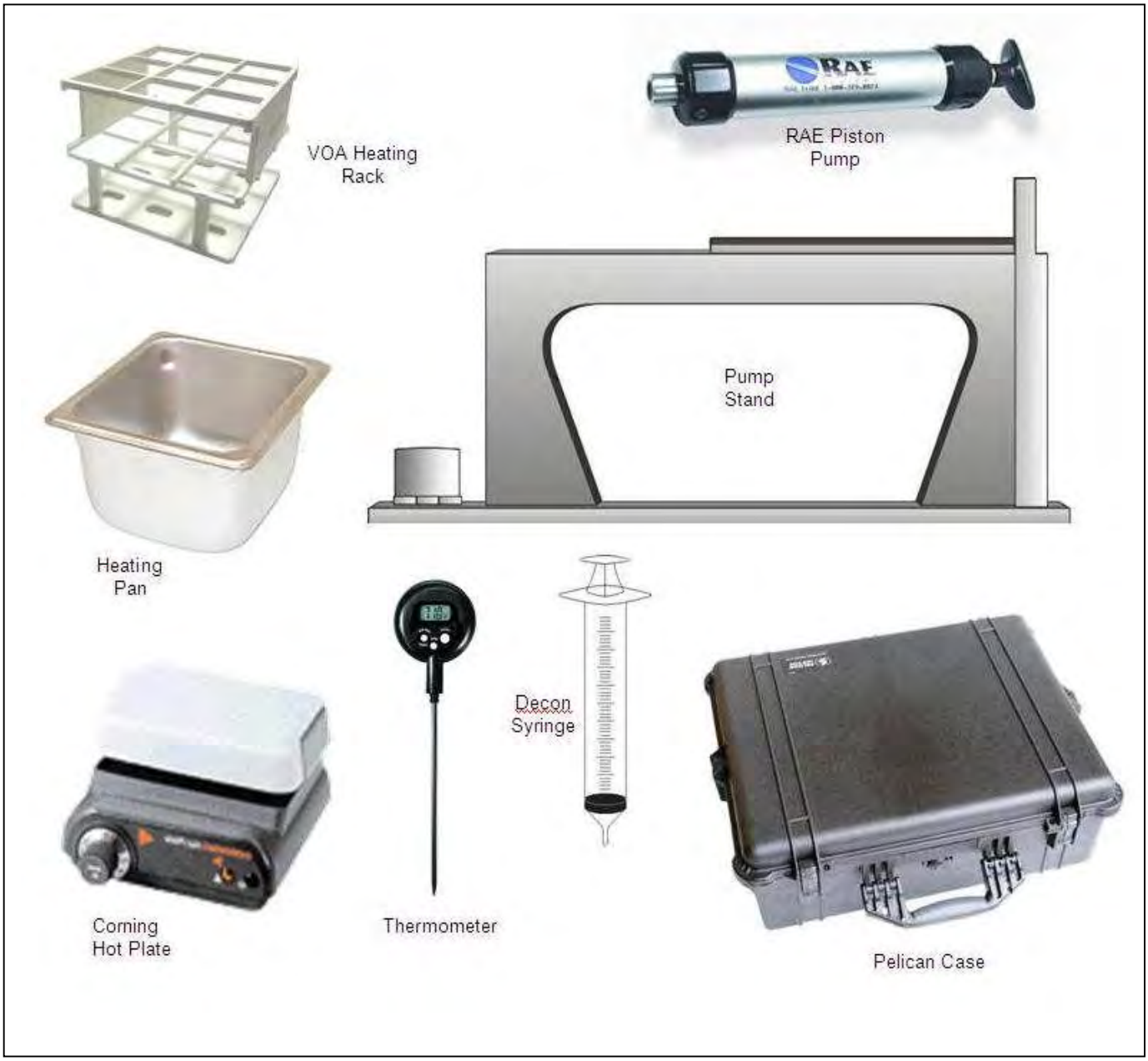


Figure 2
AQR Color-Tec® 20-Sample Expendables Pack

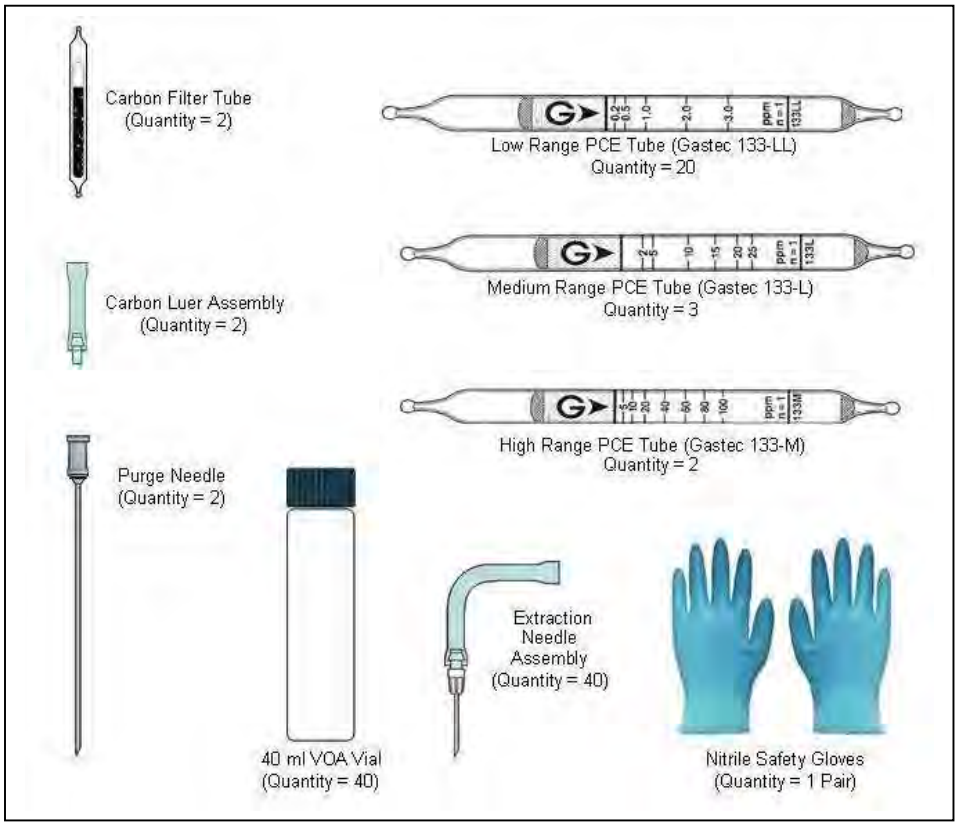
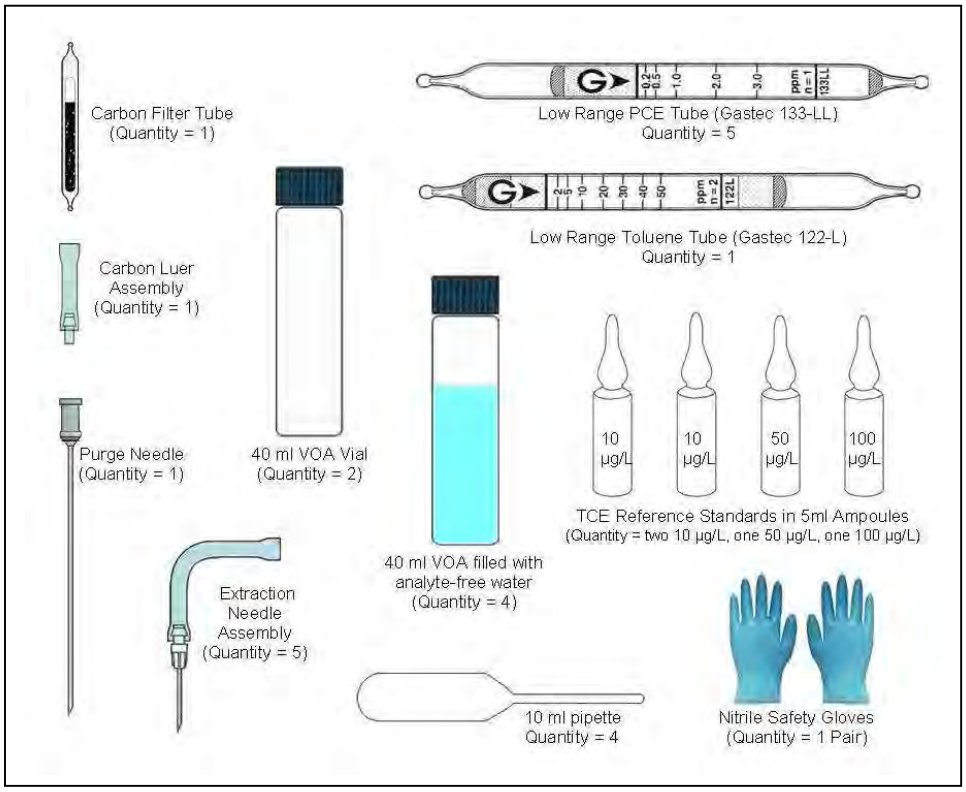


Figure 3
AQR Color-Tec® QA/QC Test Pack



2.2 Accessories Supplied by User

The following items (not provided in the AQR Color-Tec® kit) are suggested for use with the AQR Color-Tec® method to perform the listed functions.

Item	Purpose
Organic-free water	for soil sample extraction and equipment decontamination
Additional safety gloves	personal protection
Safety glasses	personal protection
120V AC power source	for hot plate
Permanent marker	labeling sample bottles
40 Milliliter VOA Vials	for split samples to be analyzed by laboratory methods

The VOA vials used to perform the AQR Color-Tec® method are provided in each kit (two vials per sample). The user may wish to collect a quantity of split samples for laboratory analysis to provide comparison data which may be used to determine site-specific method detection limits and/or to tentatively quantify AQR Color-Tec® results.

2.3 Storage & Stability of Colorimetric Tubes and Reference Standard Ampoules

The Gastec colorimetric tubes have a shelf-life of two years with refrigeration. Tubes should be stored at or below a temperature of 10°C/50°F when not in use. Colorimetric detector tubes are single-use (one tube per analysis) and should be used immediately after the tips are broken. Tube readings should be recorded immediately following analysis because the intensity of the color-change fades over time. Each box of tubes has an expiration date printed in red ink on the top of each box. When heating the tubes for use with the AQR Color-Tec® method, it is recommended that the tube temperature does not exceed 40°C/104° F.

Other procedures and guidelines associated with the use of the tubes for their designed purpose (gas detection in ambient air) are included in the tube manufactures data sheets and tube instructions included in the tube packaging.

The QA/QC reference standards are provided in 5ml flame sealed ampoules to prevent loss of volatiles and generally have a shelf life of one year with refrigeration.

2.4 Heating Colorimetric Tubes and Samples

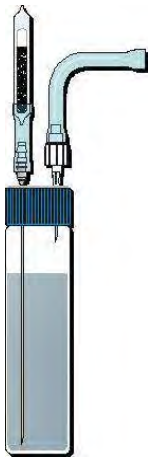
The colorimetric gas detector tubes used in the AQR Color-Tec® method were designed for the purpose of detecting volatile organic compounds (CVOHs) in **ambient air**. When using the tubes for analysis of **ambient air**, the calibrated operating temperature is 20°C/68°F. Using the tubes at temperatures above or below 20°C/68°F, for the purpose of testing **ambient air**, introduces error into the measurements requiring application of correction factors to correct that error. Because Color-Tec is an alternate use of the colorimetric tubes which concentrates CVOHs from water or soil samples into the tubes, the units (ppmV) printed on the tubes have no direct relationship to the quantity of CVOHs dissolved in the water/soil sample being analyzed and the temperature correction factors used for analysis of **ambient air** are not required when using the colorimetric tubes as part of the AQR Color-Tec® method.

However, since the colorimetric tubes are more sensitive to the presence of chlorinated compounds at 40°C/104°F, and the purpose of the AQR Color-Tec® method is to detect the presence/absence of CVOHs in water at concentrations at the lowest concentrations possible, the tubes be heated to their optimum sensitivity (40°C/104°F) to maximize their detection capability. The samples are also heated to maximize the transfer of CVOHs from the water sample to the colorimetric tube.

To heat the samples and colorimetric tubes, a hot plate is used to heat a water bath containing a test tube rack to hold the sample-filled VOA vials and unbroken colorimetric tubes (see Figure 1). Special attention must be paid to the temperature of the water to avoid prolonged overheating the samples and tubes. The samples and colorimetric tubes should not be heated in excess of 40°C/104°F.

Given the size of the heating pan and VOA rack, generally only 3 sets of samples are heated at the same time. When a pair of VOAs is removed from the heating rack and placed on the pump stand, it can be replaced with a new pair for heating. After collection, samples should remain in a cool place until ready to be heated and analyzed. It is recommended to avoid heating the samples for more than about 2 minutes to avoid loss of CVOCs.

2.5 Carbon Pre-Filter



Because ambient air is used to purge the samples, a carbon pre-filter is provided for attachment to the purge needle to prevent possible airborne contaminants from passing through the sample and entering the detector tube during the purging process. To use the carbon pre-filter, break both tips of a carbon filter tube and insert the end of the tube onto the carbon lure assembly (make sure the air-flow arrows on the carbon tube point toward the carbon lure assembly), then tightly insert the male lure fitting on the carbon lure assembly into the female lure fitting on the purge needle (see Figure 2). At sites where little or no ambient air contamination is present, a single pre-filter tube may be reused for several days. However, at sites where high concentrations of airborne chlorinated compounds are suspected or have been confirmed in the ambient air, the pre-filter tubes may need to be replaced more frequently. For most situations, one carbon filter per 20 samples is more than sufficient.

2.6 AQR Color-Tec® Work-Station Set-up

Pump Stand Set-up

1. Place the pump stand up-right on a flat stable surface.
2. Place the RAE® piston-pump into the curved tray on the top of the pump stand as shown.

Corning® Hot Plate Set-up

1. Connect the AC power cord to the back of the hot plate.
2. Connect the other end of the AC power cord to a USA 120VAC electric outlet.
3. Place the hot plate on a flat stable surface.
4. Set the hot plate thermostat control to between dial setting 4 and 5.

Hot Water Bath Set-up

1. Fill the stainless-steel water bath pan with tap water to approximately 1.5-inches from the rim.
2. Insert the VOA rack into the water-filled, stainless-steel, water bath pan.
3. Remove the cap from a 40ml VOA vial, fill the VOA vial with tap water and place it into the VOA Rack as shown. *Note: The bottom of the water-filled VOA vial should be slightly submersed in the water in the stainless-steel pan.*
4. Place the stainless-steel water bath pan onto the heating surface of the hot-plate.
5. Open a box of low-level (133LL) Gastec® tubes and place several tubes into the water-filled VOA vial. Insert the yellow reagent end of the tubes into the bottom of the VOA vial. Note: Do not place tubes with broken tips in the water bath – heating must be accomplished before breaking the tube tips.
6. Turn on the Oakton® digital thermometer and place the steel probe into the water-filled VOA vial with the colorimetric tubes.
7. Once the water bath reaches a temperature of approximately 100ºF, the colorimetric tubes and VOA vials containing samples can be heated. *Note: The temperature of the water bath should not exceed 100ºF.*

Heating Samples

1. Place both VOA vials containing the sample into the hot water bath for approximately 1 to 2 minutes.
2. Be sure that the VOA vials are tightly sealed before heating. *Note: When properly heated, the VOA vials should feel warm in the hand – DO NOT OPEN VOA VIALS AFTER HEATING.*

Carbon Filter/Purge Needle Set-up

1. Break both ends of a carbon filter tube using the tip breaker on the RAE piston pump.
2. Connect a carbon filter luer assembly to the carbon filter tube by sliding the open end of the vinyl tubing over the broken end of the carbon filter tube. Note: The carbon filter is re-used for multiple purge cycles.
3. Attach the carbon filter assembly to a purge needle by inserting the carbon filter assembly luer fitting into the purge needle luer fitting.
4. Thoroughly clean the purge needle between each sample analysis to avoid cross-contamination.

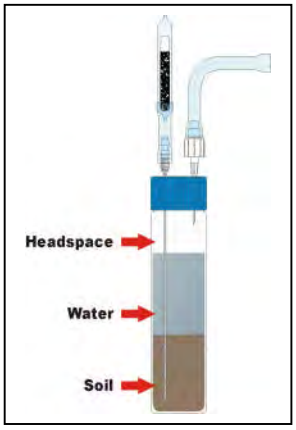
3.0 Sample Collection and Preparation

3.1 Liquid Sample Media

Collect the water or other liquid sample media directly from your sampling device into two 40 ml VOA vials by filling each vial to ~75% capacity (i.e. to about 1-inch below the shoulder of each vial). Tightly secure the caps onto the partially-filled VOA vials. The VOA vials containing the liquid sample to be tested must contain an air-filled headspace to accommodate purging. The caps must be tightened sufficiently to prevent loss of CVOHs during the time between sample collection and analysis (which includes the heating process) and to prevent air leakage during the purging process.

3.2 Solid Sample Media

Place about 1.5 inches of soil (or other solid sample media) into the bottom of each of two VOA vials (i.e. approximately 30 grams in each vial). Immediately after inserting the soil (or other solid sample media) into the two vials, add organic-free or other "clean" water to each VOA vial until they are both ~70 % full (i.e. to approximately 1-inch below the shoulder of each vial). Tightly secure the caps onto the partially-filled VOA vials. Once the caps are secure, shake the VOA vials vigorously for approximately for 5 to 10 seconds to thoroughly mix the soil and water. Additional mixing may be necessary for soil matrices comprised of clay-sized particles. The purpose of the mixing is to transfer any chlorinated compounds suspended in the soil matrix to the water to facilitate more effective purging.



IMPORTANT NOTE: The VOA vials containing the solid sample media and "clean" water must contain an air-filled headspace to accommodate purging. The caps must be tightened sufficiently to prevent loss of CVOHs during the time between sample collection and analysis (which includes the heating process) and to prevent air leakage during the purging process.

3.3 Purpose of the Duplicate Sample

The AQR Color-Tec® method is designed for use with two VOA vials (an original and a duplicate) for each sample collected. In certain situations, the duplicate sample may not be used in the performance of the method. However, the duplicate sample should always be collected in the event that it is needed to complete the analysis process. The duplicate sample may be used in either of the following situations:

- When the initial test does not induce a color change in the colorimetric tube, the second VOA vial containing the duplicate sample, may be purged (using the same colorimetric tube) to increase the probability of detecting very low (< 10 µg/L) concentrations.

- When the initial test induces a color change that exceeds the upper limit of the LL tube (a tube reading > 3), the extra VOA vial can be used to analyze the sample using higher range colorimetric tubes (133L or 133M) to tentatively quantify the higher concentration of chlorinated compounds in the sample.

4.0 Sample Analysis Procedure

1. Place both heated VOA vials (original & duplicate sample) into the two VOA holders on the pump-stand.
2. Remove a low-level tube from the hot water bath and wipe it dry.
3. Break both ends of the colorimetric tube using the tip breaker on the piston pump.
4. Insert the colorimetric tube into the pump inlet with the flow arrow (printed on the tube) toward the pump. *Note: Tube orientation is critical – the yellow reagent end of the tube is inserted in the pump.*
5. Connect an extraction needle assembly to the colorimetric tube by sliding the open end of the vinyl tubing over the broken end of the colorimetric tube.

6. Remove the protective cap from the extraction needle.
7. Insert the extraction needle into the septa of one of the VOA vials.
   Notes: Be sure that the tip of the extraction needle is positioned within the headspace of the VOA vial (above the water level). Do not insert the extraction needle as far as it will go into the headspace of the VOA vial, but rather only to a point slightly beneath the inside of the septa to reduce the possibility of sample water entering the extraction needle assembly and colorimetric tube during the purging process.
8. Insert the purge needle into the septa of the first VOA vial – push the tip needle to the bottom of the VOA vial.

9. Align the 50ml label and red dot on the RAE pump handle with the red dot on the pump shaft.
10. Pull the handle sharply until it locks in the 50ml (half pull) position.
11. Confirm that air is purging through the sample in the VOA vial.
12. Purge for approximately 30 seconds.
13. Check the yellow reagent in the tube for a color-change.
14. If no color-change reaction is visible or if the color reading is less than 1.5, rotate the pump handle ½ turn and pull the handle out to lock in the 100ml position.
15. Continue the 100ml purge until the flow cycle is complete. Note: Flow is complete when the end-of-flow indicator (located on the back of the pump handle) returns to its full brightness.
16. Check the yellow reagent phase in the tube for a color change.
17. If no color-change is visible, remove the extraction needle from the VOA with the vinyl tubing still attached to the low-level tube, rotate the pump handle ¼ turn and push the plunger back into the pump, remove the extraction needle from the first VOA vial and inject it into the septa of the second VOA (duplicate sample), then remove the purge needle from the first VOA vial and inject it into the septa of the second VOA (duplicate sample) - now re-pull the pump handle to lock into the 100ml position.
18. When the second 100ml purge cycle is complete, read and record the results.

For samples containing high concentrations (>150 µg/L) the resulting color-change may exceed the calibrated limit of the low-level tube, requiring the second VOA vial (duplicate sample) to be purged and analyzed by repeating steps 3 through 13 using a medium range (133L) or a high range (133M) tube.

For samples containing low (<5 µg/L) concentrations the color change does not usually begin until 100 CCs of air have purged through the sample. Furthermore, the color change induced at these low concentrations is very slight (below 0.5 on the tube scale) and appears as a slight darkening or light purple hue at the entrance of yellow reagent layer in the LL tube. When the sample contains higher concentrations (>10 µg/L) of chlorinated compounds, the resulting color change is an obvious light to dark purple, which propagates through the yellow reagent layer toward the pump end of the colorimetric tube. The tube reading (Color-Tec response) is obtained by matching the linear extent of the discolored reagent inside the tube to the calibration scale printed on the outside of the tube. Table 1 presents a troubleshooting matrix with causes and solutions potential problems.

Table 1 Troubleshooting Guide		
Problem	**Possible Cause**	**Solution**
Sample does not appear to be purging (bubbling) after the pump handle has been pulled.	Clogged/blocked purge (long) needle.	Use the decontamination syringe to check the purge needle for clogs. If clogged, clean the needle or use a new purge needle.
	Clogged/blocked extraction (short) needle.	Use decontamination syringe to check the extraction needle for clogs. Use decontamination syringe to clean the needle or use a new extraction needle.
	Colorimetric tube is not securely connected to hand pump.	Remove and re-insert the colorimetric tube from the hand pump. If the fit seems loose, replace the hand pump inlet gasket.
	Colorimetric tube is not securely connected to extraction needle tubing.	Check the connection between the extraction needle tubing and the colorimetric tube. If loose, insert the colorimetric tube further into the extraction needle tubing.
	VOA cap is not tightly sealed.	Check the tightness of the VOA cap. Tighten if necessary.
	Colorimetric tube tips were not broken before connecting to hand pump and tubing.	Break both tips of the colorimetric tube before connecting to hand pump and tubing.
	Broken/bad plunger seal in hand pump.	Check the pump seal by holding your finger over the hand pump inlet while pulling the pump handle and lock into the 50cc position. If no vacuum is apparent, open the pump, remove the plunger, replace the plunger seal, and grease the new seal. Re-assemble the pump.
The colorimetric tube shows no reaction after purging a sample that contains chlorinated compounds. (False Negative)	Colorimetric tube is below the optimum operating temperature.	Heat the colorimetric tube to 40°C/104° F before using. It is also recommended to heat the sample. The recommended temperature for tubes and samples when using the AQR Color-Tec® Method is 40°C/104° F.
	Colorimetric tube was connected using reversed flow direction.	Use the flow direction arrows to properly align the tube. The purged air must pass through the black oxidizer phase and the white catalyst phase before entering the yellow reagent phase.
	The sample also contains a detectable concentration of xylenes or toluene.	Samples can be tested for the presence of xylenes and toluene using the **Gastec 122L** colorimetric tube. The detection of chlorinated compounds may be diminished when xylenes or toluene are present in a sample.
The colorimetric tube indicates a reaction after purging a sample that contains no chlorinated compounds. (False Positive)	Chlorinated compounds are present at detectable concentrations the ambient air.	Test the ambient air using an LL tube to determine if chlorinated compounds are present at detectable concentrations. Attach the charcoal filter to the purge needle prior to purging samples.
	HCl vapor is present in the sample VOA or in the ambient air.	Avoid use of HCl in the area where AQR Color-Tec® is in use. Use only unpreserved VOAs for samples to be screened with AQR Color-Tec®.
	Water vapor has entered the yellow reagent phase of the tube indicating a positive reaction	NEVER purge more that 200 CCs through any sample. Stop purging before condensation inside the tube reaches the end of the black oxidizer phase. Avoid drawing any water from the sample VOA into the colorimetric tube.

5.0 Sample Purging and Detection Methodology

Samples may be purged using 50 cubic centimeters (cc), 100cc, or 200cc purge volumes. These various purge volumes are used in succession to maximize the low-level detection capability and detection range of each tube, thereby reducing the number of tubes needed to tentatively quantify the concentration of total chlorinated compounds in the sample. The pump stand is equipped with two VOA-vial holders to accommodate a second (duplicate) sample to be collected from each sampling location. This duplicate sample (collected and prepared in the same manner as the original sample) serves the following two potential purposes:

1. When purging the initial VOA vial does not induce a color change in the colorimetric tube, the second VOA vial containing the duplicate sample, may be purged (using the same colorimetric tube) to increase the probability of detecting very low (< 10 µg/L) concentrations.
2. When the initial test induces a color change that exceeds the upper limit of the LL tube (a tube reading > 3), the extra VOA vial can be used to analyze the sample using higher range colorimetric tubes (133L or 133M) to tentatively quantify the higher concentration of chlorinated compounds in the sample.

5.1 50cc Purge Volume

Initially, all samples are analyzed using a Gastec® 133-LL tube with a 50cc purge cycle. If the 50cc purge induces a color change reading of 1.5 to 3.0, read the calibration scale value aligned with the stained/unstained interface in the tube and use the pump stroke correction factors provided on the colorimetric tube instruction sheets to determine the correct reading for a 50cc purge volume. If the concentration in the sample exceeds the upper detection limit of the tube (i.e. the color change moves beyond the upper limit of the calibration scale printed on the tube), repeat the analysis using duplicate samples and higher range tubes (133-L and 133-M) until the color change reaction stops within the calibration scale on the tube. If the color change reaction exceeds the upper limit of the calibration scale of the M tube, the sample contains a concentration of chlorinated compounds above the upper detection capability of the AQR Color-Tec® Method.

5.2 100cc Purge Volume

Following completion of the 50cc purge cycle, if the concentration in the sample has induced a color change in the tube which traveled less than half the distance of the calibrated portion of the reagent phase of the tube, pull the pump handle outward and lock it into the 100cc position to complete a full purge cycle. Record the value aligned with the stained/unstained interface on the tube. No correction factor is needed for a 100cc purge.

5.3 200cc Purge Volume

Following completion of the 100cc purge cycle, if the concentration in the sample has induced no color change reaction, remove the purge needle and extraction needle assembly from the VOA vial containing the original sample and insert them into the VOA vial containing the duplicate sample (which has also been pre-heating) and perform another 100cc purge cycle **using the same colorimetric tube**. To perform the transfer to the second vial, remove both needles from the original VOA vial and immediately insert both needles into the septa of the duplicate sample VOA vial. Before re-inserting the pump handle, temporarily remove the colorimetric tube from the tip of the hand pump and re-insert the pump handle completely into the pump while the tube is un-attached. Re-attach the colorimetric tube into the pump tip and pull the pump handle and lock it into the 100cc position.

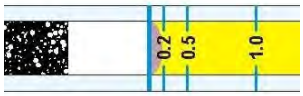
Read the calibration scale value aligned with the stained/unstained interface in the tube and use the pump stroke correction factors provided on Table 2 to determine the correct reading for a 200cc purge volume.

Table 2
Purge Volume Correction Factors for 133-Series Tubes

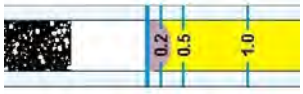
Colorimetric Tube	Purge Volume	Quantity of Pump Pulls	Correction Factor
133LL	50cc	½	Tube Reading x 3
133LL	100cc	1	Tube Reading x 1
133LL	200cc	2	Tube Reading ÷ 2
133L	50cc	½	Tube Reading x 3
133L	100cc	1	Tube Reading x 1
133L	200cc	2	Tube Reading ÷ 2
133M	50cc	½	Tube Reading x 2.5
133M	100cc	1	Tube Reading x 1
133M	200cc	2	Tube Reading ÷ 2.5

6.0 Reading the Tubes

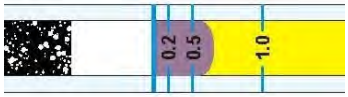
The basic AQR Color-Tec® method procedures are simple and intuitive; however, contaminant detection and semi-quantitative values are obtained through visual observation of the colorimetric reaction in the tubes, which is inherently subjective (especially in samples containing very low [<5 µg/L] total CVOHs). These low-level samples induce only a slight color change (i.e. slight darkening or light purple hue) prior to the 0.5ppm line on the tube scale at the entrance of yellow reagent layer in the LL tube. Samples containing concentrations of total chlorinated compounds above 5 µg/L usually induce a more apparent reaction within the LL tube.



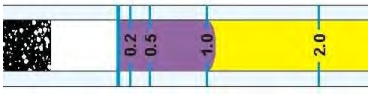
Positive Tube Result
Response Value = 0.1



Positive Tube Result
Response Value = 0.2



Positive Tube Result
Response Value = 0.6



Positive Tube Result
Response Value = 1.0

Positive Tube Result
Response Value = 2.0

6.1 Very Low Concentrations

When a sample contains very low concentrations (<10µg/L) of chlorinated compounds, the resulting color change is not immediate or distinct. At these low concentrations the color change does not usually begin until between 100 and 200 CCs of air have purged through the sample into the tube. Furthermore, the color change induced at these low concentrations is very slight (below 0.5 on the tube scale) and appears as a slight darkening or light purple hue at the entrance of yellow reagent layer in the LL tube.

6.2 Low to Medium Concentrations

When the sample contains higher concentrations (>10 µg/L) of chlorinated compounds, the resulting color change is an obvious light to dark purple, which propagates through the yellow reagent layer toward the pump end of the colorimetric tube. The detected concentration level is obtained by matching the linear extent of the discolored reagent inside the tube to the calibration scale printed on the outside of the tube.

6.3 High Concentrations

When the sample contains high concentrations (>100 µg/L) of chlorinated compounds, the color change reaction occurs quickly and usually exceeds the upper detection level of the Gastec® 133LL tube. The higher the concentration of chlorinated compounds in the sample, the faster the color change reaction occurs and the further it propagates through colorimetric tube. Samples containing percent-range concentrations (>1000 µg/L) of chlorinated compounds, often discolor the entire yellow reagent layer in the LL tube before the pump handle has been fully extended. In these cases, the purging can be discontinued to allow for the current sample bottle to be re-tested using a higher range detector tube. There is no need to continue purging the sample when the detection level of the tube is exceeded. Each subsequently higher range tube is used to purge each new duplicate sample in succession until the color change reaction does not exceed the calibration range of the tube being used.

6.4 Recording Tube Readings

It is recommended to record the observed concentration value (tube reading), the range of the colorimetric tube (LL, L, or M), and the final purge volume when logging AQR Color-Tec® results. For example, a reading of 2.5 observed on an LL tube using a 100 ml purge should be recorded as **2.5/LL/100**. Purge volume correction factors must be applied for AQR Color-Tec® values which were obtained using any purge volume other than 100cc. For example, a reading of 0.2 observed on an LL tube using a 200 ml purge should be recorded as **0.1/LL/200**. A reading of 60 observed on an M tube using a 50 ml purge should be recorded as **150/M/50.**

7.0 Estimating CVOH Concentrations from Tube Readings

The AQR Color-Tec® method is qualitative, but provides a general indication of the magnitude of the concentration present in a sample (i.e. low, medium, or high) based on the intensity/magnitude of the tube reaction (tube reading). AQR Color-Tec tube readings are used to estimate the concentration of CVOHs present in a water sample by comparing AQR Color-Tec® results to the results of split samples analyzed by GC/MS. Given a sufficient quantity of split sample pairs and sufficient range of concentration values, this comparison data can be used to obtain estimated concentrations for tube readings obtained from samples not selected for lab analysis.

7.1 Conversion Table

To provide a field-ready estimate of the total chlorinated solvent concentration in liquid and solid samples based on the colorimetric tube reading, AQR Color-Tec has developed a conversion table (see Table 3) based on statistical comparison water samples collected from chlorinated solvent sites in which the AQR Color-Tec and GC/MS methods were used to analyze split samples. The estimated concentration is obtained by matching the Color-Tec tube response to either the *median expected GC/MS concentration* or the *expected GC/MS concentration range* (see notes on Table 3 for definitions). Due to purging variables and the design of the colorimetric tubes, the potential range of corresponding analytical values associated with each positive tube reading is broad and increases significantly as the sample concentration increases. It should be emphasized that the analytical results presented on Table 3 are strictly estimates that represent the central tendency of the comparison data. Actual analytical values may differ substantially from this estimate and may fall outside of the corresponding ranges provided on Table 3.

The expected GC/MS concentrations presented in Table 3 are based on comparison of water sample data only. These conversion values may also be used for soil data; however, the potential range in expected GC/MS concentrations may be increased as a result of the difference in soil volumes used in the two methods and in the inherent heterogeneity of most soil matrices. However, the potential deviation factors included in the *expected GC/MS concentration range* column should be sufficient to account for the intrinsic analytical variability of most soil sample results.

Table 3

Conversion of AQR Color-Tec Responses to Total Chlorinated Volatile Organic Halocarbon Concentrations

AQR Color-Tec Tube Response (Tube Reading)	Median Expected GC/MS Concentration (liquid samples) (µg/L)	Range of Expected GC/MS Concentrations (liquid or solid samples) (µg/L or µg/kg)	
		Low	High
0	3	Below MDL	5
0.1	7	5	10
0.2	15	10	20
0.3	25	15	30
0.4	30	20	40
0.5	35	25	45
0.6	45	30	60
0.7	55	35	70
0.8	60	40	80
0.9	70	45	90
1	75	50	100
1.5	120	75	160
2	160	100	220
2.5	210	125	295
3	275	150	360
5	450	250	640
10	1,300	650	2,000
15	1,900	900	2,800
20	2,500	1,100	3,800
25	3,300	1,400	5,200
30	4,400	1,750	7,000
35	5,500	2,150	9,100
40	7,000	2,600	11,600
45	10,000	3,550	17,000
50	15,000	4,750	24,500
60	16,000	5,000	26,400
70	17,000	5,250	28,300
80	18,000	5,500	30,200
90	19,000	6,000	32,200
100	20,000	6,000	34,200
120	24,000	7,000	40,000
150	32,000	9,000	55,000
180	41,000	11,000	70,000
200	46,000	12,000	80,000
250	63,000	15,000	110,000
280	74,000	18,000	130,000
300	85,000	20,000	150,000

MDL = Analytical method detection limit

Notes:

The **Color-Tec Tube Response/Reading** (Color-Tec units) is the value printed on the colorimetric tube at the interface between the reacted and un-reacted reagent (the extent of the color change in the tube for a positive result).

The **Median Expected GC/MS Concentration** is the estimated concentration in micrograms per liter (µg/L) of total chlorinated volatile organic halocarbons (CVOHs) present in the sample for the corresponding Color-Tec tube response.

The **Expected GC/MS Concentration Range** is an estimated range of potential concentrations (µg/L or µg/kg) of total chlorinated volatile organic halocarbons (CVOHs) for the for the corresponding Color-Tec tube response.

The **Median Expected GC/MS Concentration** was obtained using statistical comparison of Color-Tec Method data and GC/MS (EPA Method 8260B) data. Comparison data were obtained from 5348 **water** samples collected from 152 chlorinated solvent (primarily PCE) sites in which the Color-Tec Method was used to analyze the samples in the field and either a laboratory based or mobile GC/MS was used to analyze split samples.

The **Expected GC/MS Concentration Range** reflects the potential deviation in the **Median Expected GC/MS Concentration** based on Color-Tec Method/EPA Method 8260B comparison results. The potential error increases as the concentration increases. The initial deviation factor used for a Color-Tec Reading of zero is +/- 30% and increases to +/- 400% at a Color-Tec Reading of 300 units.

The **Median Expected GC/MS Concentrations** presented in this table are based on comparison of water sample data only. These conversion values may also be used for soil data; however, the potential error or range in expected GC/MS concentrations may be increased as a result in the difference in soil volumes used in the two methods and in the inherent heterogeneity of many soil matrices. The potential deviation factors included in the **Expected GC/MS Concentration Range** data should be sufficient to account for the intrinsic analytical variability of most soil sample results.

The expected GC/MS concentrations in this table are provided only to give Color-Tec Method users an approximate concentration for the Color-Tec Tube Response. Actual GC/MS results on split samples may be outside of the stated range for a given Color-Tec Tube Response.

Refer to the **AQR Color-Tec Manual** for detailed information regarding general method principals and potential analytical variables.

8.0 QA/QC Procedures (For use with QA/QC Test Pack)

To insure that consistent results and the lowest possible detection levels are achieved for all samples analyzed using this method, standard sample preparation procedures tailored to specific project goals should be developed by the user and followed precisely and consistently throughout the sampling and analysis program.

This section of the manual describes procedures which are performed using the *AQR QA/QC Test Pack*, which provides the user with a basic methodology for conducting quality assurance/quality control (QA/QC) procedures for the AQR Color-Tec® method. Users of the method are encouraged to develop project-specific QA/QC and sample handling procedures that insure the level of consistency and accuracy required for the user's sampling program. This section presents some basic method-specific, QA/QC procedures developed to insure overall **method performance**, provide **analytical confidence**, identify potential **false positives** such as contaminants in the ambient air (since ambient air is used as the purge gas), and identify potential **false negatives** such as the presence chemical inhibitors that may be present in the samples or in the ambient air.

8.1 Method Performance and Analytical Confidence

Using the method to analyze 10ug/L, 50ug/L, and 100ug/L sample spikes will provide a comparison of AQR Color-Tec® readings to known concentrations, which provides a basis for estimating approximate concentrations in the field samples based on the AQR Color-Tec® responses. Testing of the higher range tubes using spiked samples is unnecessary because the high range tubes are usually not used unless the sample being tested has already exceeded the upper range of the low range tube, thus revealing that the sample being tested contains a sufficient quantity of chlorinated compounds to evoke a positive reaction from the next higher range tube.

8.2 False Negatives

The presence of Toluene and Xylenes inhibits/diminishes the ability of the colorimetric tubes to detect CVOHs. At sites where the presence of these compounds is suspected to be present in the samples or in the ambient air (since ambient air is used as the purge gas), QA procedures may include periodic testing of groundwater or soil samples and ambient air for the presence of toluene and xylenes using a Gastec® Toluene tube (the Toluene tube also detects xylenes).

8.3 False Positives

Because the AQR Color-Tec® method uses ambient air as the purge gas, airborne chlorinated compounds at low concentrations can enter the sample and activate the detector tube. To prevent airborne contaminants from entering the sample and detector tube during sample purging and analysis, the method is used with a carbon pre-filter attached to the purge needle. To determine whether airborne chlorinated contaminants are present, a colorimetric tube may used periodically to test the ambient air at the location where the field testing is being performed. It airborne contaminants are present and the carbon filter is being used, the carbon filters can also be tested periodically using a colorimetric tube to determine if breakthrough is occurring. A build-up of water vapor in the colorimetric tube past the catalyst stage (black portion of the tube) can induce a subtle color change similar to that of a low-level positive result. This problem is easily avoided by observing the build-up of condensation inside the tube in the catalyst stage during purging, and stopping the airflow before the condensation reaches the end of the catalyst stage. This condition rarely occurs before the maximum required purge volume of 200 CCs is achieved and contaminant presence or absence has been determined.

8.4 Preparation of Spiked Samples for Method Performance QA/QC Tests

Spiked control samples are used to insure that the method is detecting the target compounds within reasonable limits and to provide a basis for estimating concentrations based on the AQR Color-Tec® responses. Sample spikes are prepared by combining the Cerilliant® TCE reference standards (provided in four 5 ml glass ampoules) with pre-measured, analyte-free water (provided in four VOA vials labeled with green [two vials], yellow, and red stickers on the caps). After transferring the reference standards from the ampoules to the four VOA vials, the vials will contain TCE concentrations of 10 µg/L (green label [two vials]), 50 µg/L (yellow label), and 100 µg/L (red label). To prepare your spiked samples for Color-Tec analysis, transfer each reference standard (in the glass ampoules) to each water-filled VOA as follows:

Reference Standard (Glass Ampoule)		Add the contents of each glass ampoule to each water-filled VOA	VOA Vial for Spike (pre-filled with water)	
Ampoule Label	**Concentration Before Dilution**		**Sticker Color**	**Concentration after Dilution**
TCE-60	60 µg/L	→	**Green**	10 µg/L
TCE-60	60 µg/L	→	**Green**	10 µg/L
TCE-300	300 µg/L	→	**Yellow**	50 µg/L
TCE-600	600 µg/L	→	**Red**	100 µg/L

Step 1 - Carefully break open one of the TCE-60 ampoules by grasping the body of the ampoule in one hand and the tip of the ampoule containing the plastic breaking collar in the other hand and apply bending pressure against the neck of the ampoule using your thumbs and index fingers. The tip of the ampoule should break along the scored restriction in the neck of the ampoule.

Step 2 - After breaking the ampoule, use a clean 10 ml pipette to carefully transfer all of the liquid from the ampoule into the VOA vial containing analyte-free water marked with the green label. Tightly re-seal the VOA cap and shake the sample for 5 seconds to mix. The first 10 µg/L spiked sample is now ready to pre-heat and test using the Color-Tec® method.

Prepare the second 10 µg/L spiked sample by repeating steps 1 and 2 using the second TCE-60 ampoule and the second VOA vial containing analyte-free water marked with a green label. Two 10 µg/L spikes are used because concentrations of 10 µg/L and below sometimes require the second 100cc purge (discussed in Sections 4.3 and 5.3) to see the color change.

To prepare the 50 µg/L spiked sample, repeat steps 1 and 2 using the TCE-300 ampoule and the VOA vial containing analyte-free water marked with a yellow label.

To prepare the 100 µg/L spiked sample, repeat steps 1 and 2 using the TCE-600 ampoule and the VOA vial containing analyte-free water marked with a red label.

The spiked samples are now ready to be analyzed using the AQR Color-Tec® method.

IMPORTANT NOTES: Be sure to transfer all of the liquid in the ampoule to the VOA vial and use care to prevent any spillage of the liquid from the VOA vial. Transfer the liquid as gently as possible and as quickly as possible to avoid loss of volatiles. The liquid in the ampoules and VOA vials have been precisely pre-measured to result in two 10 µg/L, one 50 µg/L, and one 100 µg/L sample spikes after mixing.

8.5 Method Performance QA/QC Test Procedure

The Color-Tec® readings obtained from testing the 10ug/L, 50ug/L, and 100ug/L sample spikes provides comparison to known concentrations to provide a basis for estimating approximate concentrations in the field samples based on the Color-Tec® responses. Following preparation of the 10 µg/L, 50 µg/L, and 100 µg/L sample spikes, heat the spiked samples and three 133LL tubes as described in section 8. After heating, conduct Color-Tec® analyses on the samples as described in Sections 3 and 4 and record the results in your field log as described in Section 5.3. A 200cc purge (as described in Section 4.3) may be required (using the second 10ug/L prepared spike) to produce a positive color-Tec reading when testing the 10 µg/L spiked samples. Any sample containing 10 µg/L or less of total CVOHs may require a 200cc purge (using two VOA vials) to produce a positive Color-Tec reading.

8.6 Negative Interference (Xylenes/Toluene) QA/QC Test Procedure

To conduct a test for the presence of compounds which could inhibit the detection of CVOHs use the Toluene (122L) tube to analyze a duplicate soil or water sample using the procedures described in Sections 2 through 4.

8.7 Positive Interference (Ambient Air) QA/QC Test Procedure

To conduct a test for the presence of chlorinated VOHs in the ambient air, break the tips of a 133LL colorimetric tube and properly insert it into the hand pump. Pull and lock the pump handle into the 100cc position allowing ambient air to enter the colorimetric tube. *Note: Do not attach an extraction needle assembly to the colorimetric tube while performing this test.* Once the 100cc flow cycle is completed, carefully read the tube and record the results. A positive result indicates the presence of CVOCs in the ambient air at concentrations detectable by AQR Color-Tec® which would affect sample results unless the carbon filter assembly is attached to the purge needle (see Section 9). A negative result indicates that CVOCs are not present in the ambient air at concentrations detectable by AQR Color-Tec® and therefore will not affect sample results. It is recommended that the carbon filter assembly is used regardless of the ambient air testing results.

8.8 Duplicate Sample Testing Procedure

Duplicate or replicate samples are collected from the same sampling location, at the same time, using the same collection methods, and analyzed using the same procedures as the original samples for the purpose of determining both sampling and analytical method variability. Since a second (duplicate) VOA vial is always collected for the Color-Tec® method, a duplicate or replicate analysis may be performed on the second (duplicate) VOA vial any time that a positive result (color change) is evoked by the original sample (first VOA vial) without exceeding the upper limit of the low-level colorimetric tube. In those cases, the duplicate or replicate analysis is simply performed by using a new low-level colorimetric tube to analyze the duplicate sample in the second (unused) VOA vial. If sampling and method variability is low, the result of the duplicate test will be the same or similar to the results obtained from the original test. The relative percent difference (RPD) may be calculated to quantify any variability in the results.

8.9 Collection of Split Samples for Laboratory Analysis

It is recommended that sample splits be collected for laboratory comparison analysis from 5 to 20 percent of the total quantity of samples analyzed using the AQR Color-Tec® method. Given a sufficient quantity of split sample pairs and sufficient range of concentration values, the GC/MS-to-AQR Color-Tec® comparison data may be used to obtain estimated concentrations for samples in the data set which were analyzed only using the AQR Color-Tec® method. This can be achieved using linear regression analysis of the comparison data. Statistical analysis of the comparison data can also be performed to determine site-specific AQR Color-Tec® method performance data.

9.0 Safety Precautions

As with the use of any product, it is recommended that the user carefully review all product manuals and Material Safety Data Sheets (MSDS) provided with this product prior to use. Several components of the AQR Color-Tec® kit are products obtained from other manufacturers which have manuals including safety precautions. Users of the AQR Color-Tec® method should carefully review the manuals and safety precautions and should become familiar with the proper use of all components included in the AQR Color-Tec® kit. It is recommended that the procedures involved with the method be incorporated into the user's Site-specific Safety and Health Plan (SSHP). MSDSs for all chemicals provided as part of the AQR Color-Tec® kit are available upon request. The following precautions should be considered to reduce potential user safety risks associated with the performance of the AQR Color-Tec® method.

Activity	Potential Risk	Precaution
Breaking tube tips	eye injury, dermal puncture	safety glasses
Accidental tube breakage	dermal cuts, exposure to reagent	safety gloves
Use of purge/extraction needles	dermal puncture	use caution
Use of the hot plate	dermal burns, electric shock	limited setting
Use of PCE standards	dermal contact, dermal cuts	safety gloves

Additional Safety Notes:

- Use skin and eye protection while breaking colorimetric and carbon filter tubes;
- The thermostat dial setting of the Corning® Hot Plate should never be set above 5 for any heating purposes required by the AQR Color-Tec method®;
- Do not over-fill the water bath pan while heating the samples and tubes;
- Always conduct sample and tube heating activities on a flat, stabile, surface.
- Keep all flammable or combustible materials away from the Corning® Hot Plate during sample and tube heating activities.
- Always use the stainless-steel water-bath pan properly filled with water for heating the samples and tubes – do not heat samples or tubes directly on the surface of the Corning® Hot Plate;
- Do not use any heat source to heat the water-bath, tubes, or samples other than the Corning® Hot Plate provided in the hardware kit.

Disposal of Expendable Materials:

- Re-cap all needles before disposal;
- After re-capping each extraction needle, dispose of the extraction needle assembly while leaving the vinyl tubing attached to the colorimetric tube – Do not attempt to remove the extraction needle assembly from the tip of the colorimetric tube for disposal;
- Dispose of all sharps (needles and broken glassware) in accordance with any and all applicable local and/or federal rules or guidance.
- Dispose of all colorimetric tubes as specified in the Gastec® MSDS and/or in accordance with any and all applicable local and/or federal rules or guidance.
- Dispose of any remaining spiked-sample liquids as specified in the Cerilliant® MSDS and/or in accordance with any and all applicable local and/or federal rules or guidance.
- Dispose of all VOA vials used to contain sample materials in accordance with any and all applicable local and/or federal rules or guidance.

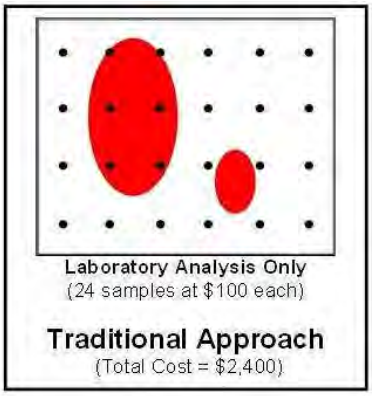
Product Warranty

Air Quality Research warrants that the goods sold herein will be free from defects in material and workmanship. This warranty shall be limited to the replacement of defective parts. It is expressly agreed that this warranty shall be in lieu of all warranties of fitness and in lieu of the warrant of merchantability.

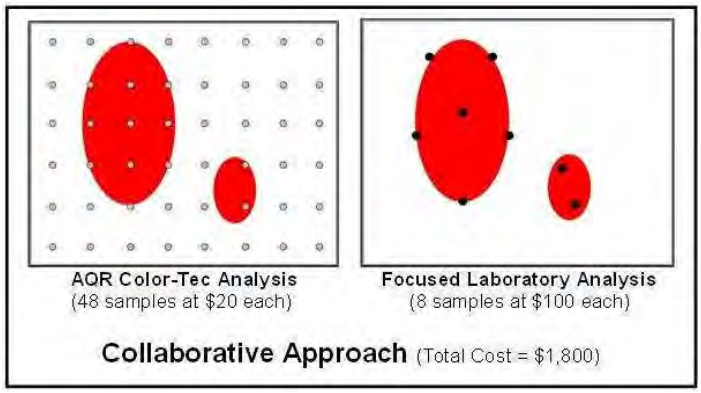
10.0 AQR Color-Tec® Method Applications

Source Area Identification at chlorinated solvent sites is highly complex given the low solubility of these compounds in water. Chlorinated solvent source zones often persist as suspended residual in unsaturated and saturated subsurface sediments for many decades. Surface water infiltration and groundwater flowing through the source zones slowly dissolves the suspended residual solvent leading to substantial aqueous phase contaminant plumes. Given the high volatility of most chlorinated compounds, residual solvents suspended in the unsaturated soil often leads to significant vapor phase contamination. The AQR Color-Tec® method is ideal for locating chlorinated solvent source areas by combining low level detection of all chlorinated compounds with low per sample cost to allow for significant expansion of sampling coverage compared to assessment approaches where only definitive analytical (laboratory) methods are employed to locate source areas. Definitive laboratory analysis provides high analytical accuracy, but sampling quantity is often limited to control costs, resulting in data gaps, sampling uncertainty, and low overall data quality. The low per-sample cost of AQR Color-Tec® method offers a 5:1 increase in analysis volume over laboratory methods, allowing for five times the sampling coverage for the same cost.

The illustrations below compare the traditional approach of source identification which uses only definitive laboratory analysis, to a collaborative approach which uses a high volume of AQR Color-Tec® data combined with a low quantity of definitive laboratory data. This collaborative approach combines high volume/low accuracy with low volume/high accuracy to achieve higher overall data quality than either method alone.



The diagram to the left shows the traditional site investigation scenario in which all samples collected are analyzed using only definitive analytical methods. The red areas represent previously unidentified source areas and black dots represent sampling locations intended to locate and delineate the contaminant plumes. Although this definitive-analysis only approach provides high analytical accuracy, the sampling quantity is often limited in order to control costs, resulting in data gaps, sampling uncertainty, and low overall data quality – and in this example the smaller source area remains undetected.



The two diagrams to the right show an investigation scenario in which a real-time measurement method, such as AQR Color-Tec®, is used to increase the overall sampling coverage, resulting in reduced sampling uncertainty and increased overall data quality. In this example, the smaller source area is identified and the AQR Color-Tec® data is verified and confirmed by focusing a reduced quantity of definitive, laboratory-based, analysis of split-samples onto the most critical areas of the site. Combining AQR Color-Tec® with focused laboratory analysis in this manner provides increased overall data quality and analytical accuracy at significantly lower costs than conventional approaches which rely only on definitive laboratory-based analysis.

Groundwater Profiling is the collection of discrete samples at multiple depths and locations working outward from known source areas to define the lateral and vertical extent of a dissolved groundwater contaminant plume. The technique is used in conjunction with the AQR Color-Tec® method at chlorinated solvent sites to allow for immediate decisions regarding subsequent vertical and lateral sampling locations.

Soil Matrix Profiling is similar to groundwater profiling, but uses sampling of the unsaturated soil to define the lateral and vertical extent of the vapor phase contamination.

Groundwater Matrix Profiling (Residual Zone Mapping) is similar to groundwater or soil profiling, but uses sampling of saturated unconsolidated aquifer matrix to define the lateral and vertical extent of suspended residual DNAPL.

Surface Water/Sediment/Pore Water Impact Evaluation is the collection and analysis of sediment, sediment pore water, and surface water to locate and characterize groundwater impacts on surface water.

AQR Color-Tec®

Contact and Ordering Information

- **For more information visit www.aqrcolortec.com**
- **For kit orders contact Phil Pecevich at 919-918-7191**
  Email: pecevica@bellsouth.net
- **For training or kit orders contact Felecia Owen at 919-278-8926**
  Email: fowen@aqrcolortec.com
- **For training or technical support contact Perry Kelso at 850-933-2312**
  Email: pkelso@aqrcolortec.com

Equipment and Expendables

- **Hardware kit includes piston pump, pump stand, and heating equipment in a Pelican® hard case**
- **Expendables provided in 20-sample packs**
- **Expendables for QA/QC tests sold separately**
- **Cost per sample is $24**
- **Volume discounts available**
- **Professional technical support is included with every purchase**
- **Professional in-house or web-based training is available**

Hardware Kit

20-Sample Pack

QA/QC Pack

APPENDIX B

FIELD FORMS

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SOIL BORING LOG

PROJECT NUMBER:	BORING NUMBER:	SHEET: of

Project Name		Site	
Client		Geologist	
Date		Weather	
Drilling Company		Rig Type/ Drilling	
Boring Size		Hammer Drop	
Sample Method		# of Samples	
Total Depth		Depth to GW	
Northing/ Easting		Elevation	

LOCATION SKETCH/EXTRA FIELD NOTES: N

[surface condition, ie. Asphalt, grass]

DEPTH (FEET)	BLOWS/FT	INCHES DRIVEN	INCHES REC'VED	PID	TIME	USCS Classification	SOIL DESCRIPTION AND NOTES (color, major constituents/minor constituents [particle distribution and particle shape], density, plasticity, cohesiveness, moisture content, fracturing, weathering, depositional environment, stratigraphic unit)
0							
1							
2							
3							
4							
5							
6							
7							
8							
9							

WELL CONSTRUCTION LOG

PROJECT NUMBER:	WELL NUMBER:	SHEET: of

PROJECT NAME		SITE	
CLIENT		SCIENTIST	
DATE		WEATHER	
DRILLING COMPANY		RIG TYPE	
BORING SIZE		DRILLING METHOD	
TOTAL DEPTH		WELL TYPE	
NORTHING		DEPTH TO GW	
EASTING		ELEVATION	

LOCATION SKETCH/EXTRA FIELD NOTES: N
[surface condition, ie. Asphalt, grass]

DEPTH (FEET)	FIELD ILLUSTRATION	WELL INSTALLATION INFO	SOIL DESCRIPTION	WELL DATA
0				Monument Type: _____ Surface Seal: _____ Stickup Height: _____ ____ -inch Schedule PVC Well Casing Screened Interval: _____ ____ " Slotted Screen Other:

GROUNDWATER SAMPLING FORM

PROJECT NUMBER:	WELL NUMBER:	SHEET:
		of

PROJECT NAME

CLIENT

DATE

SITE

GEOLOGIST

WEATHER/ TEMPERATURE

WIND

WELL CONDITION

DAMAGE PRESENT

DEPTH TO WATER (FROM TOC)

DEPTH TO BASE (FROM TOC)

HEIGHT OF WATER COLUMN

WELL VOLUME

NOMINAL DIAMETER	O.D.	I.D.	VOLUME (GAL/LIN FT)
2"	2.375"	2.067"	0.17
3"	3.5"	3.068"	0.38
4"	4.5"	4.026"	0.66
6"	6.625"	6.065"	1.50
8"	8.625"	7.981"	2.60

SAMPLING DATA

SAMPLE TYPE (GW, PRODUCT, OTHER):

SAMPLE COLLECTED WITH: __ Bailer ____ Pump, Type: _____ ___ Other, Specify:

MADE OF: __ Stainless Steel ____ PVC

__ Teflon ____ Disposable LDPE ___ Other, Specify:

SAMPLING DECON PROCEDURE:

SAMPLE DESCRIPTION: (color, free product thickness, odor, turbidity)

FIELD WATER QUALITY PARAMETERS

Time	Flow Rate (mL/min)	Water Level	Draw Down	Temperature (°C)	Spec. Cond. (µS/cm)[c]	D.O. (%)	D.O. (mg/L)	pH	ORP (mV)	Turbidity (NTU)	Color	Odor

ANALYTICAL SAMPLE INFORMATION

Analyte	Time	Identification	Additional Sample	Time	Identification
VOC			Duplicate		
Dhc					
MNA					
CSIA					
Other					

Sampling Notes:

APPENDIX C

GENE-TRAC® SAMPLING PROTOCOL

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SiREM
Leading Science · Lasting Solutions

130 Research Lane, Ste 2
Guelph ON N1G 5G3
(519) 822-2265

GROUNDWATER COLLECTION AND SHIPPING PROTOCOL FOR GENE-TRAC® SAMPLES

There are two sampling methods for Gene-Trac testing: A) conventional groundwater sample collection; and B) field filtration (i.e., groundwater solids collected on a filter). Procedures for both sampling methods are provided in this document. SiREM is pleased to provide sampling supplies (containers or filters, blue ice, coolers) free of charge upon request (please provide 3 days advance notice for this service). Note: customers are responsible for payment of shipping charges (outbound and incoming).

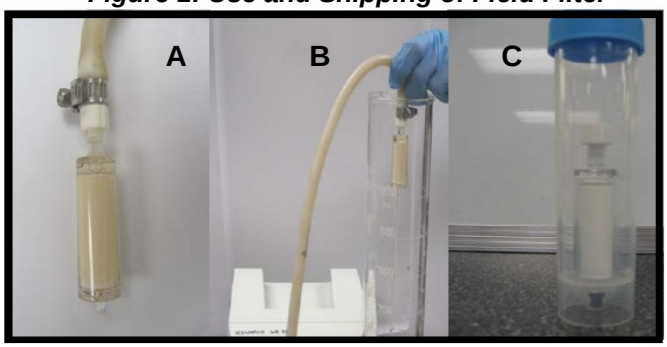
Sample Collection Methods: Prior to sample collection, sampling points should be purged using industry-accepted groundwater purging protocols to obtain representative groundwater. Note: turbidity in groundwater samples is not a concern.

Method A: Conventional Groundwater Samples (collect 1 liter per sample location)
After sample point purging, groundwater samples are collected in large mouth 1-liter (L) high-density polyethylene (HDPE) bottles (e.g., Nalgene or equivalent) with minimum achievable headspace. No preservatives are required; samples should be stored and shipped at 4ºC.

Method B: Field Filtration Samples (2 filters required per sample location)

1) Remove filter from storage container and insert Luer Lock adapter (white fitting) into pump effluent tubing (1/4" – 5/16" inside diameter) and securely fasten using a gear clamp (Figure 1A).

Figure 1: Use and Shipping of Field Filter



2) Turn on pump and direct filter discharge into a graduated container (Figure 1B). Pass up to 1L of water through the filter and record the measured volume of water passed through the filter (in L or milliliters [mL]). Should the filter clog prior to filtration of 1 L, shut off the pump and record the measured volume passed through the filter. Dispose of effluent groundwater in accordance with applicable site procedures.

3) Cap the effluent end of the filter (while full of water) with the small black cap; decouple the tubing/ Luer Lock fitting from the influent end of the filter and seal the filter unit with the white cap. Place the sealed filter the 50 mL container, label with the sample location, date and total volume of groundwater passed through the filter (Figure 1C). The filters should be stored and shipped at 4ºC.

4) Remove the Luer Lock fitting clamped to the tubing and discard.

Sample Labeling and Handling: Samples should be clearly labeled (including sample ID and date) and individually sealed in re-sealable freezer bags then placed in a cooler with cool packs (preferred). If ice is used it must be double bagged. Sample hold time is 10 days at 4ºC.

Chain-of-Custody: The completed chain-of-custody should be placed in a zip-lock bag inside the cooler with the samples. Include: the total volume passed through the filter for each sample (Method B only); the applicable purchase order number, and quotation number where applicable; and indicate which of the following analyses are requested:

Method 1: Gene-Trac-Dhc *(Dehalococcoides)*
Method 2: Gene-Trac VC (vinyl chloride reductase [*vcrA*])
Method 3: Gene-Trac-Dhb (*Dehalobacter*)

Shipping: Ship samples by priority overnight courier to SiREM. Total value of samples should be given a total value of no more than $10; otherwise a 15% duty will be applied to the stated value (to be paid by customer).

Shipping Documentation: The following shipping documents are required for sample shipment.

1) **International Air Waybill (e.g., FedEx)**

Section 1: Fill in date, complete shipping address and include your FedEx account number
Section 2: Your internal reference number/project number (if required)
Section 3: To address is: (already completed)

SiREM
Sample Reception
130 Research Lane Suite 2
Guelph, Ontario, Canada N1G 5G3

Section 4: Fill in number of packages, total weight and under the Commodity Description describe as *"**groundwater samples for destructive analysis"***
Maximum value for customs purposes should be $10.
Section 5: FedEx International Priority
Section 6: Other packaging
Section 7: Do not check either box (SiREM cannot accept Saturday deliveries)
Section 8: Payment and customs charges by Sender
Section 9: Signature

See attached Sample FedEx International Air Waybill. Complete shipper specific information (yellow/shaded), other information should be completed as indicated.

2) Canada Customs (Commercial) Invoice

The Canada Customs Invoice (see electronically editable attached PDF) replaces the standard commercial or pro forma invoice. The following fields must be completed on the Canada Customs Commercial Invoice.

Field 1: Address of Shipment Origin
Field 2: Date of shipment
Field 8: Courier name
Field 11: Total number of pieces being shipped
Field 12: Describe as "groundwater samples for destructive analysis"
Field 16: Total weight

See attached sample Canada Customs Invoice. Complete shipper specific information (yellow/shaded), other information should be completed as indicated.

Technical Inquiries:
Phil Dennis 519-822-2265 ext. 238/ pdennis@siremlab.com
Ximena Druar 519-822-2265 ext. 286/ xdruar@siremlab.com

Shipping Inquiries/Sampling Supplies:
Twyla Gilbert 519-822-2265 ext. 255/ tgilbert@siremlab.com

Attachments: (1) Sample Fed Ex International Air Waybill
(2) Sample Canada Customs Invoice

Canada Customs and Revenue Agency | Agence des douanes et du revenu du Canada

CANADA CUSTOMS INVOICE
FACTURE DES DOUANES CANADIENNES

Page 1 of de 1

1. Vendor (name and address) - Vendeur (nom et adresse)

ENTER YOUR NAME, COMPANY & ADDRESS

2. Date of direct shipment to Canada - Date d'expédition directe vers le Canada

ENTER DATE

3. Other references (include purchaser's order No.)
Autres références (inclure le n° de commande de l'acheteur)

4. Consignee (name and address) - Destinataire (nom et adresse)

SAMPLE RECEPTION
SiREM
130 RESEARCH LANE, SUITE 2
GUELPH, ON N1G 5G3 CANADA
TEL: 519-822-2265, EX. 255

5. Purchaser's name and address (if other than consignee)
Nom et adresse de l'acheteur (s'il diffère du destinataire)

6. Country of transhipment - Pays de transbordement

7. Country of origin of goods
Pays d'origine des marchandises
USA

IF SHIPMENT INCLUDES GOODS OF DIFFERENT ORIGINS ENTER ORIGINS AGAINST ITEMS IN 12.
SI L'EXPÉDITION COMPREND DES MARCHANDISES D'ORIGINES DIFFÉRENTES, PRÉCISEZ LEUR PROVENANCE EN 12.

8. Transportation: Give mode and place of direct shipment to Canada
Transport : Précisez mode et point d'expédition directe vers le Canada

FEDEX

9. Conditions of sale and terms of payment
(i.e. sale, consignment shipment, leased goods, etc.)
Conditions de vente et modalités de paiement
(p. ex. vente, expédition en consignation, location de marchandises, etc.)

SAMPLES FOR DESTRUCTIVE ANALYSIS

10. Currency of settlement - Devises du paiement

USD

11. Number of packages Nombre de colis	12. Specification of commodities (kind of packages, marks and numbers, general description and characteristics, i.e., grade, quality) Désignation des articles (nature des colis, marques et numéros, description générale et caractéristiques, p. ex. classe, qualité)	13. Quantity (state unit) Quantité (précisez l'unité)	Selling price - Prix de vente 14. Unit price Prix unitaire	15. Total
1	GROUNDWATER SAMPLES FOR DESTRUCTIVE ANALYSIS	1.000 unit/unité	10.00	10.00
		unit/unité		0.00
		unit/unité		0.00
		unit/unité		0.00
		unit/unité		0.00
		unit/unité		0.00
		unit/unité		0.00
		unit/unité		0.00
		unit/unité		0.00
		unit/unité		0.00
		unit/unité		0.00
		unit/unité		0.00

18. If any of fields 1 to 17 are included on an attached commercial invoice, check this box ☐
Si tout renseignement relativement aux zones 1 à 17 figure sur une ou des factures commerciales ci-attachées, cochez cette case
Commercial Invoice No. / N° de la facture commerciale _____

16. Total weight - Poids total
Net: TOTAL LBS.
Gross - Brut:

17. Invoice total
Total de la facture
10.00

19. Exporter's name and address (if other than vendor)
Nom et adresse de l'exportateur (s'il diffère du vendeur)

NOT APPLICABLE

20. Originator (name and address) - Expéditeur d'origine (nom et adresse)

NOT APPLICABLE

21. CCRA ruling (if applicable) - Décision de l'Agence (s'il y a lieu)

22. If fields 23 to 25 are not applicable, check this box ☑
Si les zones 23 à 25 sont sans objet, cochez cette case

23. If included in field 17 indicate amount:
Si compris dans le total à la zone 17, précisez :

(i) Transportation charges, expenses and insurance from the place of direct shipment to Canada
Les frais de transport, dépenses et assurances à partir du point d'expédition directe vers le Canada

(ii) Costs for construction, erection and assembly incurred after importation into Canada
Les coûts de construction, d'érection et d'assemblage après importation au Canada

(iii) Export packing
Le coût de l'emballage d'exportation

24. If not included in field 17 indicate amount:
Si non compris dans le total à la zone 17, précisez :

(i) Transportation charges, expenses and insurance to the place of direct shipment to Canada
Les frais de transport, dépenses et assurances jusqu'au point d'expédition directe vers le Canada

(ii) Amounts for commissions other than buying commissions
Les commissions autres que celles versées pour l'achat

(iii) Export packing
Le coût de l'emballage d'exportation

25. Check (if applicable):
Cochez (s'il y a lieu) :

(i) Royalty payments or subsequent proceeds are paid or payable by the purchaser
Des redevances ou produits ont été ou seront versés par l'acheteur ☐

(ii) The purchaser has supplied goods or services for use in the production of these goods
L'acheteur a fourni des marchandises ou des services pour la production de ces marchandises ☐

Dans ce formulaire, toutes les expressions désignant des personnes visent à la fois les hommes et les femmes.

CI1 (00)

FedEx Express

International Air Waybill
Lettre de transport aérien internationale

For FedEx services worldwide. / Pour les services internationaux de FedEx.

/0063/0100/0044149139/3

Sender's Copy / Copie expéditeur

1 From *Please print and press firmly.* / **Expéditeur** *Écrivez en caractères d'imprimerie. Appuyez fermement SVP.*

Date MM/DD/YY

Sender's FedEx Account Number / N° de compte FedEx de l'expéditeur

Sender's Name / Nom de l'expéditeur

Phone / Téléphone VERY IMPORTANT

Company / Nom de la société

Address / Adresse

Dept./Floor/Service/Étage

Address / Adresse

City / Ville

Province

CANADA

Postal Code / Code postal

2 Your Internal Reference / Votre référence interne OPTIONAL/FACULTATIF

First 24 characters will appear on invoice. / Les 24 premiers caractères apparaîtront sur la facture.

3 To / Destinataire

Recipient's Name / Nom du destinataire SAMPLE RECEPTION

Phone / Téléphone 5198222265

Company / Nom de la société SIREM

Address / Adresse

Dept./Floor/Service/Étage

Address / Adresse 130 RESEARCH LANE SUITE 2

City / Ville GUELPH

State / Province/État ON

Country / Pays CA

ZIP/Postal Code / Code postal N1G5G3

Recipient's Tax ID Number Required for Customs Purposes / N° fiscal du destinataire aux fins de la douane

e.g. GST/RFC/VAT/IN/EIN/ABN, or as locally required./ex. TPS/CEF/TVA/NI/EIN/ABN, ou selon la loi du pays.

4 Shipment Information / Informations sur l'envoi

Total Packages / Nombre total de colis

Shipper's Load and Count/SLAC / Envoi chargé et vérifié par l'expéditeur/ECVE

Total Weight / Poids total ☐ lb. ☐ kg

DIM / Poids VOL L / W / H (Long / Larg / Haut) ☐ in. / po ☐ cm

Commodity Description / Description de la marchandise	Harmonized Code / Code harmonisé	Country of Manufacture / Pays de fabrication	Value for Customs / Valeur déclarée à la douane
groundwater samples for destructive analysis			$10 -

Canada Export Declaration/B13A: / Déclaration d'exportation/B13A:

☐ No B13A required. / B13A non exigée.

☐ Manual B13A attached. / B13A remplie manuellement et jointe.

☐ B13A filed electronically. / B13A enregistrée électroniquement.

☐ B13A Summary Reporting. / B13A Rapport sommaire.

Total Declared Value for Carriage / Valeur totale déclarée pour le transport

Total Declared Value for Customs / Valeur totale déclarée à la douane (Specify Currency) (Préciser la monnaie)

Auth. ID/Form ID# / N° ID form./ID. aut.

5 Express Package Service / Service colis express *Packages up to 150 lb. (68 kg) / Colis de 68 kg (150 lb) ou moins*

☒ FedEx International Priority

☒ FedEx International First — Available to select locations. / Disponible à certains endroits.

☒ FedEx International Economy — FedEx Envelope and FedEx Pak rates not available. / Les tarifs Enveloppe FedEx et Pak FedEx ne sont pas disponibles.

6 Packaging / Emballage *These unique boxes with special pricing are provided by FedEx for FedEx Intl. Priority only. / Ces boîtes uniques offertes sont fournies par FedEx pour les envois FedEx Intl. Priority seulement.*

☒ FedEx Envelope / Enveloppe FedEx

☒ FedEx Pak / Pak FedEx

☐ FedEx Box / Boîte FedEx

☐ FedEx Tube / Tube FedEx

☒ Other / Autre

☒ FedEx 10kg Box* / Boîte 10kg FedEx*

☒ FedEx 25kg Box* / Boîte 25kg FedEx*

7 Special Handling / Manutention spéciale

☐ HOLD at FedEx Location / RETENIR à la succursale FedEx — May not be in the same city. / Peut être située dans une autre ville.

☐ SATURDAY Delivery / Livrer le SAMEDI — Available to select locations for FedEx Intl. Priority only. / Disponible à certains endroits, pour FedEx Intl. Priority seulement.

8 Payment / Paiement *Complete payment options for both transportation charges and duties and taxes. / Inscrire les options de paiement pour les frais de transport et les droits et taxes.*

Bill transportation charges to: / Facturer le transport à :

Enter FedEx Acct. No. or Credit Card No. below. / Indiquer ci-dessous le n° de compte FedEx ou de la carte de crédit.

☑ Sender / Expéditeur — Acct. No. in Section 1 will be billed. / Les frais seront imputés au numéro de compte figurant à la rubrique 1.

☐ Recipient / Destinataire

☐ Third Party / Tierce partie

☐ Credit Card / Carte de crédit

☐ Cash/Cheque / Argent liquide Chèque

FedEx Acct. No. / N° de compte FedEx

Credit Card No. / N° de carte de crédit

Credit Card Exp. Date / Date d'expiration de la carte de crédit

Credit Card Auth. / Autorisation de carte de crédit

Bill Customs charges to: / Facturer les droits de douane à :

Enter FedEx Acct. No. below. / Indiquer le n° de compte FedEx.

☑ Sender / Expéditeur — Acct. No. in Section 1 will be billed. / Les frais seront imputés au numéro de compte figurant à la rubrique 1.

☐ Recipient / Destinataire

☐ Third Party / Tierce partie

All shipments may be subject to Customs charges, which FedEx does not estimate prior to clearance. / Tous les envois peuvent être assujettis à des frais de douane, dont FedEx ne peut fournir l'estimation avant le dédouanement.

FedEx Acct. No./N° de compte FedEx

9 Required Signature / Signature requise

Use of this Air Waybill constitutes your agreement to the Conditions of Contract on the back of this Air Waybill, and you represent that this shipment does not contain dangerous goods. Certain international treaties, including the Warsaw Convention, may apply to this shipment and limit our liability for damage, loss, or delay, as described in the Conditions of Contract./En utilisant la présente lettre de transport aérien, vous acceptez les conditions du contrat indiquées au verso et vous garantissez que cet envoi ne contient pas de marchandises dangereuses. Certains traités internationaux, y compris la Convention de Varsovie, peuvent s'appliquer à cet envoi et limiter notre responsabilité pour tout dommage, perte ou retard, tel que précisé dans les Conditions du contrat.

Sender's Signature / Signature de l'expéditeur

This is not authorization to deliver this shipment without a recipient signature. / Ceci ne constitue pas une autorisation de livraison de cet envoi sans la signature du destinataire.

For Completion Instructions, see back of fourth page./Pour des instructions, voir le verso de la quatrième page. Questions? Visit fedex.ca or call 1.800.GoFedEx 1.800.463.3339./Des questions? Visitez fedex.ca ou composez le 1.800.GoFedEx 1.800.463.3339.

For packages over 150 lb. (68 kg), dangerous goods, or Broker Select, please use the FedEx Expanded Service International Air Waybill. Not all services and options are available to all destinations. Veuillez utiliser la lettre de transport aérien internationale détaillée pour les envois de marchandises dangereuses ou de colis de plus de 68 kg (150 lb), ou encore si vous utilisez l'option Broker Select. Certains services et options ne sont pas disponibles pour toutes les destinations.

575

PART 167620•Rev. Date 9/09 ©1994–2009 FedEx PRINTED IN U.S.A. RRDA

FedEx Tracking Number / Numéro de suivi de FedEx 8764 0079 6003

Form ID No. / N° du formulaire 0412

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COMMERCIAL INVOICE LABEL / ÉTIQUETTE DE LA FACTURE COMMERCIALE 876400796003

DELIVERY RECORD LABEL / ÉTIQUETTE D'AVIS DE RÉCEPTION 876400796003

DELIVERY REATTEMPT LABEL / ÉTIQUETTE D'AVIS DE SECONDE TENTATIVE DE LIVRAISON 876400796003

APPENDIX D

SITE-SPECIFIC HEALTH AND SAFETY PLAN

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SITE SPECIFIC HEALTH AND SAFETY PLAN
FOR FOCUSED
GROUNDWATER CHARACTERIZATION
ALASKA REAL ESTATE PARKING LOT
ANCHORAGE, ALASKA
APRIL 2, 2014

Prepared For:

Alaska Department of Environmental Conservation
Division of Spill Prevention and Response
555 Cordova Street
Anchorage, AK 99501

Prepared By:
Ahtna Engineering Services, LLC
110 W 38th Ave., Suite 200A
Anchorage, AK 99503

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SITE SPECIFIC EMERGENCY INFORMATION

Title	Name	Phone Number
EMERGENCY		
Ambulance		911
Fire		911
Police		911
Closest Hospital	Alaska Regional Hospital	(907) 276-1131
PERSONNEL		
AES Contract Manager	Nino Muniz	Office: (907) 433-0731 / Cell: (b) (6)
AES Project Manager	Olga Stewart	Office: (907) 865-3865 / Cell: (b) (6)
AES Field Team	Alex Geilich	Office: (907) 433-0728 / Cell: (b) (6)
AES SSHO	Olga Stewart	Office: (907) 865-3865 / Cell: (b) (6)
AES CIH, CSP	Pete Rice	Office: (916) 372-2000 / Cell: (b) (6)
Client Project Manager	Grant Lidren	Office: (907) 269-8685
SUBCONTRACTORS		
GeoTek Alaska - AK	Travis Drewry	Office: (907) 569-5900
OnSite Environmental - WA	Karl Hornyik	Office: (425) 883-3881
Microseeps – PA	Robbin Robl	Office: (412) 826-5245
SiREM – Ontario	Jeff Roberts	Office: (519) 515-0852
Emerald – AK	Roxanne Peterson	Office: (907) 258-1558

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ACRONYMS AND ABBREVIATIONS

ADEC.....Alaska Department of Environmental Conservation
AES .....Ahtna Engineering Services Limited Liability Company
AST .....aboveground storage tank
CC .....Crisis Coordinator
C.I.H.....Certified Industrial Hygienist
CPR.....cardiopulmonary resuscitation
C.S.P. .....Certified Safety Professional
EPA.....United States Environmental Protection Agency
°F.....degrees Fahrenheit
HSP .....Site-Specific Health and Safety Plan
IIPP .....Injury Illness and Prevention Program
mg/m3 .....milligram per cubic meter
MSDS.....Material Safety Data Sheets
NIOSH .....National Institute for Occupational Safety and Health
OSHA.....Occupational Safety and Health Administration
PADS .....Physical Agent Data Sheets
PEL .....Permissible Exposure Limit
PID .....photoionization detector
PM.....Project Manager
PPE.....personal protective equipment
ppm .....parts per million
REL .....Recommended Exposure Limit
SSHO .....Site Safety and Health Officer
VOC .....volatile organic compound
U.S. .....United States
UST .....underground storage tank
WP.....work plan

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1.0 INTRODUCTION

The Ahtna Environmental, Inc. (AES) Injury Illness and Prevention Program (IIPP) dated June 2010 will be utilized for general AES corporate health and safety issues. In addition, this Site-Specific Health and Safety Plan (HSP) has been prepared by AES as a supplement to the IIPP to address site-specific health and safety concerns associated with the Focused Groundwater Characterization in Anchorage. The work plan describes the investigation and monitoring activities to be performed by AES.

Control of the site potential hazards involves the entire crew understanding and implementing the provisions of this HSP. Employees are ultimately responsible for their own safety and the safety of those working around them. Employees will be required to follow safe work practices, use appropriate monitoring equipment and personal protective equipment (PPE) correctly, and follow emergency procedures when required. The AES Project Manager (PM) has the overall responsibility for ensuring that the means are available to supply site personnel with the appropriate equipment, tools, material, and PPE when required. The Site Safety and Health Officer (SSHO) shall be responsible for ensuring the implementation and enforcement of this HSP during project activities.

This HSP provides guidelines and procedures for protecting the health and safety of individuals performing work at the project site. In addition, this HSP presents an analysis of potential physical and chemical hazards that may exist at the work site or may arise in relation to the conduct of planned activities. Based on the hazard analysis, recommended controls are provided to eliminate or reduce the hazards that may be present. The provisions of this HSP are mandatory for all activities conducted at the site under the direction of AES.

It is a requirement of this HSP that an approved copy be kept at the project site. In addition, all AES personnel assigned to the project site are required to read, understand, and comply with the provisions and requirements for this HSP, including attachments and documents incorporated by reference. AES personnel will document such understanding and compliance by signing the Health and Safety Plan Acknowledgement Form included in Appendix A.

1.1 Site Location

The Alaska Real Estate Parking Lot site is located at the northeast corner of 4th Avenue and Gambell Street in Anchorage, Alaska, approximately 1.3 miles east of Cook Inlet's Knik Arm. The approximate location is latitude 61° 13'17.81" north and longitude -149° 52'11.95" west within Section 18, Township 13 North, and Range 3 West of the Seward Meridian.

1.2 Site History

Three structures were previously located on the property: a dry cleaner in one building on the west side of the property from 1968-1970 and a tire center/automotive shop located in two buildings on the eastern side of the property from 1976-1978 (E&E, 2013). Contamination found at the site includes VOCs typically associated with dry cleaning, including PCE, and one of its breakdown products trichloroethylene (TCE). Three other breakdown products cis-1,2-

dichloroethylene (cDCE), trans-1,2-dichloroethylene (tDCE), and vinyl chloride (VC) have not been detected at the site but have been detected downgradient.

The property is generally flat at approximately 110 feet above mean sea level. The surrounding area has a gentle slope to the north towards the Ship Creek drainage at which point a steep drop-off in elevation occurs. To the north of the site are residential buildings including single- and multi-family dwellings. Further north is the former location of the Alaska Native Hospital.

1.3 Contaminants of Concern

Contaminants of concern (COCs) are based on historic groundwater sampling in the area are VOCs, specifically PCE and TCE. Daughter products cDCE, tDCE, and VC and other VOCs have been found in select areas downgradient.

1.4 Site Activities

Ahtna will execute the following tasks to meet the project objectives:

- Install and develop two monitoring wells along Ingra Street in the public right-of-way.
- Sample thirteen monitoring wells for water quality parameters and volatile organic compounds (VOCs).
- Sample five monitoring wells for geochemical parameters indicative of monitored natural attenuation (MNA).
- Sample four monitoring wells for compound specific stable isotope analysis (CSIA).
- Sample three monitoring wells for the *Dehalococcoides* (Dhc) microorganism.
- Report field observations, findings, analytical results, and conclusions.
- Evaluate and report remedial options for the groundwater PCE plume.

2.0 JOB HAZARD ANALYSIS

Potential hazards associated with this project include physical and chemical hazards. The following sections discuss the physical, chemical, and biological hazards anticipated during site operations and the measures to be implemented by AES to eliminate or minimize these hazards.

2.1 Physical Hazards

Physical hazards are inherently present during most field operations and include the following.

- Use of heavy equipment;
- Vehicular traffic;
- Slips, trips, or falls;
- Lifting heavy objects;
- Cuts and/or bruises;
- Mechanical hazards associated with the use of tools and other equipment;
- Excessive noise;
- Inclement weather; and
- Stress due to heat or cold.

A copy of applicable Alaska State Physical Agent Data Sheets (PADS) and Material Safety Data Sheets (MSDS) will be available onsite during site activities and are attached in Appendix B.

2.1.1 Slips, Trips, or Falls

Many of the activities at this site can expose workers to slip, trip, or fall hazards. Work areas will be maintained in as neat and orderly a state as practical to prevent slips, trips, or falls. Equipment will not be stored in foot-traffic routes. Tools and materials will not be left lying around when not in direct use. All AES site staff will ensure work areas are clean and orderly. Care will be taken when walking through or working in uneven terrain (e.g., berms, vegetation, ditches, etc.) or on wet surfaces. Good footwear and constant awareness will help reduce slips, trips, and falls. Prior to initiating site activities, work areas shall be inspected to identify pre-existing slip, trip, and fall hazards. Pre-existing slip, trip and fall hazards shall be marked, barricaded, or removed prior to the initiation of site activities.

2.1.2 Lifting Heavy Objects

Many activities may require lifting heavy objects or heavy physical labor. For manual material handling tasks, personnel will be trained in proper lifting techniques. When heavy objects must be lifted manually, workers will keep the load close to the body, use their legs to lift and avoid any twisting or turning motions to minimize stress on the lower back. An adequate number of personnel or an appropriate mechanical device will be used to lift or handle heavy objects whenever feasible.

2.1.3 Using Tools and Equipment

Hazards present during the use of tools and equipment are generally associated with improper tool handling, not wearing PPE, or inadequate maintenance. Management of these hazards will involve rigorous maintenance of tools and equipment and employee training in the proper use of various tools prior to use to ensure safe working condition. Defective tools and equipment shall be immediately removed from service for repair or replacement.

2.1.4 Utilities

Project activities require intrusive subsurface activities and extreme care and proper planning will be used in order to avoid contact with underground and/or overhead power lines, water and sanitary sewer lines, storm drains, and other utilities if present at the project site. Safe distances of at least 10 feet will be maintained from overhead power lines to booms, masts, and other such equipment extensions, if applicable. If underground utilities are present or suspected to be present, hand excavation, probing, or other suitable means shall be used to locate the utilities when intrusive activities are within three feet of the expected utility location.

2.1.5 Excessive Noise

Work on this project may subject workers to noise in excess of allowable limits, particularly when working near vehicles, heavy equipment, drilling equipment, or gasoline- and electric-powered tools and equipment. Personnel who do not need to be near loud equipment should stay away to lower the risk of noise-induced hearing loss. Personnel who must work near such equipment will be required to wear hearing protection (earplugs or muffs) to reduce their exposure to excessive noise. The use of ear plugs or ear-muffs is mandatory when noise prevents conversation in a normal voice at a distance of three feet. This “rule of thumb” is an indication that noise levels may exceed the OSHA action level of 85 decibels (time-weighted average). Personnel required to wear hearing protection will be in a Hearing Conservation Program in compliance with 29 CFR 1910.95. Methods used to comply with OSHA hearing conservation requirements are set forth in the AES IIPP.

2.1.6 Inclement Weather

Weather is an important consideration in site operations. Extremely hot or cold weather, high winds or heavy rains can cause physical discomfort, loss of efficiency, and increase the potential for stress and personal injury. At the direction of the SSHO, work will be stopped in the event of high winds (over 30 miles per hour), heavy rain, lightning, or hail.

2.1.7 Heat or Cold Stress

During the proposed field activities, heat or cold stress may become a significant risk factor and personnel should be trained on how to recognize and prevent heat/cold stress illnesses. Cold stress monitoring will consist of observing workers at rest or at work for symptoms of exposure, including numbing of extremities, shivering, apathy, or listlessness. The wind chill factor will also be taken into consideration. Workers will avoid removing sweat-soaked clothing until in a

warm area. The SSHO will ensure that all workers potentially exposed to low temperatures are properly clothed.

The SSHO will initiate a heat stress monitoring program whenever personnel are wearing semi-permeable or impermeable protective clothing and the outside temperature reaches 70 degrees Fahrenheit (°F). Heat stress monitoring is not anticipated for this project.

2.1.8 Material Handling

Pinch points and crush by/struck by hazards are present when personnel are required to work in close proximity to material handling equipment. The following procedures shall be implemented when handling field equipment and materials.

- Personnel shall keep their fingers out of pinch points such as between rigging material and forks on equipment of the sides of the containers.
- Personnel shall not position themselves between material handling equipment and the containers or be permitted to walk or stand under a suspended load
- Spotters shall be provided when ground personnel are working near material handling equipment.

Ground personnel shall wear reflective, high-visibility vests when working near material handling equipment.

2.2 Chemical Hazards

During monitoring well installation, development, and sampling, personnel exposure to chlorinated solvents is possible. Routes of exposure include inhalation of vapors, direct dermal contact with contaminated materials, and ingestion of contaminated materials

Symptoms of exposure and OSHA thresholds are found in Table 2-1. Based on the OSHA action level for VC, the field screening threshold will be set at 0.5 ppm. If the field screening threshold is continually exceeded in the breathing zone of workers, exposure will be reduced by moving away and/or upwind from the source. If this cannot be achieved, the level of PPE will be upgraded to protect site workers from chemical exposure.

TABLE 2-1: OSHA THRESHOLDS AND SYMPTOMS OF EXPOSURE

Contaminant	OSHA Exposure Limits	IDLH	Exposure Symptoms
PCE	Carcinogen TWA: 100 ppm C: 200 ppm	150 ppm	Irritation to eyes/skin/nose/throat, nausea/flushed face/neck, dizziness/drowsiness
TCE	Carcinogen TWA: 100 ppm C: 200 ppm	1000 ppm	Irritation to eyes/skin/nose/throat, nausea/dizziness/drowsiness, irregular heartbeat
cDCE, tDCE	TWA: 200 ppm	1000 ppm	Irritation to eyes/throat, depressed central nervous system

Contaminant	OSHA Exposure Limits	IDLH	Exposure Symptoms
VC	Carcinogen TWA: 1ppm C: 5ppm	ND	Irritation to eyes/throat, dizziness/drowsiness, headaches, loss of consciousness

Key:
C Ceiling concentration not to be exceeded for any part of the workshift
IDLH Immediately Dangerous to Life or Health
ND Not Determined
TWA Time Weighted Average not to be exceeded during any 8-hr workshift of 40-hr workweek

The SSHO shall be responsible for ensuring that proper PPE and personal hygiene practices are available and implemented during the performance of project activities to reduce the possibility of exposure to contaminated media through inhalation or dermal contact. Care will be taken to avoid causing dust to become airborne. If dust becomes a factor, half-face respirators with HEPA filters will be worn. Leather outer gloves will be worn during most activities.

2.3 Biological Hazards

There is the possibility for exposure to insects (i.e. mosquitoes). Employees will wear long pants, socks, long-sleeved shirts, and if necessary, head-nets when outdoors to reduce the chances of being bitten by mosquitoes.

3.0 TRAINING REQUIREMENTS

AES personnel assigned to this project site will obtain health and safety clearances before and beginning work, and:

- Participate in the AES medical surveillance program, in accordance with 29 CFR 1910.120.
- Have successfully completed a 40-hour Hazwoper course in accordance with 29 CFR 1910.120.
- Have successfully completed an 8-hour Hazwoper refresher course within the past 12 months in accordance with 29 CFR 1910.134.
- Have received proper respirator fit testing in accordance with the AES written respiratory protection program and 29 CFR 1910.134.

In addition to the training requirements listed above, the SSHO must hold a valid certificate in first aid and CPR Training from the American Red Cross, or an equivalent agency.

Visitors to the project site, including regulatory agency personnel, must first receive a site-specific briefing by the SSHO.

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4.0 SAFE WORK PRACTICES

The following safe work practices will be implemented to support health and safety at the project site:

- AES site personnel and authorized visitors will be required to read this HSP and comply with its contents completely. Personnel will sign the Health and Safety Plan Acknowledgment Form presented in Appendix A.
- PPE will be worn as required by this HSP (anticipated to be level D PPE).
- Equipment will be maintained in proper working order, free of accumulated lubricants, contaminants, or other hazardous of flammable substances.
- Fuels or other flammable substances will be kept at least 50 feet away from the ignition sources. Fuel containers and other containers of hazardous substances will be properly labeled.
- Good housekeeping will be practiced at all times.
- Tools will be kept clean and maintained in good working condition.
- Personnel will report to the project site ready for work and free from the influence of alcohol, illegal or controlled substances, and prescription or non-prescription pharmaceuticals that may affect their ability to work safely.
- Personnel are required to report all injuries, near misses, and incidents to the SSHO, even if the incident is considered minor.
- Personnel will follow the direction of the SSHO on the safety or health matters, stop-work orders, or emergency evacuations.
- Personnel are expected to obey medical or work restrictions and to inform the SSHO (or, in case of subcontractors, their employer's supervisor) of any potentially relevant medical conditions that may affect their safety or the safety of others.
- Personnel are expected to maintain a high level of safety awareness.
- Personnel are expected to identify and report unsafe conditions, damaged or inadequate PPE, and other conditions that they believe are potentially hazardous.
- Face and hands must be thoroughly washed upon leaving a contaminated or suspected contaminated area.
- Excessive facial hair that interferes with a satisfactory fit of the respirator-to-face seal will not be permitted when site conditions dictate necessity of respirator use.
- Contact with potentially contaminated substances will be avoided. Personnel will not walk through puddles, pools, or mud; kneel on the ground; lean or sit on equipment; or place monitoring equipment or tools on potentially contaminated surfaces.
- Equipment decontamination will be performed in an appropriate level of PPE.
- If personnel do not fulfill health and safety responsibilities, they will be denied site access.

The SSHO will monitor weather conditions. Operations will be suspended during periods of inclement weather.

4.1 Contaminant Monitoring

Contaminant monitoring will be conducted as specified in Section 2.2.

4.2 Personal Protective Equipment

PPE will be worn during project activities. The initial level of PPE required is Level D, absent modification due to air monitoring results or other site conditions. The typical equipment necessary for Level D PPE is as follows:

- Hard hat
- Safety glasses
- Steel-toed work shoes or boots
- Leather gloves for equipment operators
- Nitrile gloves for environmental technicians
- Hearing protection (muffs or plugs), as needed
- Long pants and long-sleeved shirts or cloth coveralls
- High visibility vests

If required, Level D PPE may be upgraded to Modified Level D or to Level C. Modified Level D PPE includes the above items plus Tyvek® coveralls and nitrile or rubber outer gloves. Level C PPE is the same as Modified Level D, but includes a half-face air purifying respirator fitted with organic vapor cartridges.

4.3 Personnel Decontamination

Decontamination for personnel wearing Level D PPE will consist of the requirement for site personnel to wash their hands, arms, face, and neck prior to eating, drinking, and smoking. Disposable boot covers, if worn, should be removed and placed in a trash bag for disposal. Decontamination for Modified Level D and Level C will be as follows:

- Wash boots or boot covers and outer gloves, if worn, with a long-handled brush in a wash basin containing detergent (Alconox or equivalent) and water.
- Rinse boots and outer gloves, if worn, with water using a long-handled brush in a wash basin containing water.
- Remove tape used to seal the gloves and boot covers, if worn, and place in appropriate container.
- Remove outer gloves and place in appropriate container.
- Remove respirator, if worn, and place on equipment table for decontamination.
- Place inner gloves in appropriate container.
- Wash hands, arms neck and face prior to eating, drinking, or smoking.
- Personnel are advised to shower as soon as possible after leaving the site.

Respirators, if worn, shall be decontaminated in a 4-stage process that includes an initial wash with soap and water, a rinse in clean water, a 5-minute soak in a bleach and water solution (or other appropriate disinfectant recommended by the respirator manufacturer), and a final rinse in clean water. Respirators should be permitted to air dry in a clean atmosphere and should be properly stored when not in use.

4.4 Equipment Decontamination

Equipment shall be decontaminated prior to demobilization as described in the work plan.

4.5 Safety Meetings

Project personnel must attend a comprehensive pre-job health and safety orientation to be conducted by the SSHO prior to the start of project activities. The SSHO will review the contents of this HSP and communicate the nature and extent of potential physical and chemical hazards at the site. At a minimum, project health and safety orientations shall include the following topics:

- Names of personnel and alternates responsible for site safety and health
- Physical and chemical hazards anticipated during project activities
- Symptoms of overexposure to chemicals of concern
- Emergency response procedures and location of emergency equipment
- Prevention, symptoms, and treatment for heat/cold stress
- PPE (initial PPE levels, action levels)
- Instructions for use of satellite phone
- Emergency numbers and route to airstrip for Medevac pickup
- Decontamination procedures

Each morning prior to the start of operations, site personnel will receive job specific, safety briefings. Daily safety meetings will be used to complete required onsite training requirements and to review site hazards and the controls that will be implemented to control those hazards. Attendance at the daily safety meetings shall be mandatory for all site personnel, and attendance shall be documented. A Daily Tailgate Safety Meeting form is provided in Appendix C.

4.6 Record Keeping

Copies of all pertinent safety materials, including certificates, programs, plans, safety meeting attendance sheets, and other related safety documents, will be kept on the site and maintained by the SSHO. During demobilization, the project files will be transported to the AES Anchorage, Alaska office for document retention.

4.7 Communication

AES accounts for communications in our project locations by cellular phones and e-mail. In addition, AES recognizes the importance of experienced field staff to reduce the need to depend on communications with outside project management to maintain project efficiency and outcome.

4.8 Subcontractors

Subcontractors will be responsible for the health and safety of their personnel. AES will provide a copy of this HSP and other related information to its subcontractors. Subcontractor employees will be required to attend the daily safety meetings. Failure to conform to basic safety procedures

and correct problems immediately will result in disciplinary actions that may include termination.

5.0 EMERGENCY PROCEDURES

5.1 Emergency Equipment

Emergency equipment will be stored at appropriate onsite locations selected during site mobilization. Emergency response equipment may be moved from one location to another based on changing locations of activities. The following is a list of emergency equipment that will be on site:

- Fire extinguisher (20 pound A/B/C type)
- First aid kit (At least one industrial first-aid kit will be provided and maintained fully stocked at the site.)
- Drinking water
- Absorbent pads
- Shovels and other miscellaneous hand tools

5.2 Local Emergency Information

Emergency telephone numbers are presented on the inside cover of this HSP.

Personnel with minor injuries that require more than field first aid will be transported to the Alaska Regional Hospital in Anchorage, Alaska (see Figure 1).

5.3 Emergency Response Procedures

The SSHO has the responsibility and authority for coordinating emergency response activities until proper authorities arrive and assume control. In addition, the SSHO has the responsibility of alerting emergency services personnel (see emergency telephone numbers listed above) of the need and/or arrival of emergency medical transport and ensuring that such transport has full access to injured personnel.

When calling for assistance in an emergency situation, the following information should be provided:

- Name of caller
- Caller's location
- Name(s) of person(s) exposed or injured
- Nature of emergency
- Actions taken

The recipient of the call should hang-up first- **not** the caller.

5.4 Releases or Spills

In the case of a release of fuels, lubricants, or other hazardous substances, the SSHO will be immediately contacted. She will then immediately contact the ADEC Project Manager.

5.5 Fire or Explosion

In the event of a fire, the Anchorage Fire Department will be notified immediately. If the area is not safe, evacuate the area immediately. If it is safe to do so, trained site personnel may:

- Use fire-fighting equipment available on site to control or extinguish the fire.
- Remove or isolate flammable or other hazardous materials that may contribute to the fire.

In the event of an explosion, all personnel will be evacuated, and the local fire department will be notified immediately. No one will re-enter the area until it has been cleared by the fire department or other safety personnel.

5.6 Reporting of Accidents and Injuries

The AES PM and the ADEC PM will be immediately notified in writing in the event of a serious incident, including those requiring a physician's treatment. Near misses and accidents, without regard to their severity, will be reported in writing to the AES PM within 24 hours. The SSHO will complete this documentation. A worker's compensation form will also be submitted to the State in which an injured employee resides. The appropriate agency(ies) will also be notified, if required. Following any serious incident, an investigation will be completed by the SSHO and, if necessary, the PM. The AES PM will be responsible for following up on recommendations from the investigation. Necessary corrective actions will be taken to prevent recurrence of similar incidents. Accident/Injury/Illness/Incident Report forms are presented in Appendix D.

The following types of incidents are considered reportable:

- Physical injury (a log of first aid administered on site will be kept)
- Fire, explosions, or flashes
- Serious infractions of safety rules and requirements
- Unexpected chemical exposures
- Near misses
- Vehicular accidents
- Property damage
- Injuries to the public
- Damage to private property
- Bites or stings

The following types of incidents are to be reported immediately to the AES PM:

- Those likely to result in death or permanent disability
- Those requiring hospitalization
- Those involving two or more employees
- Those that are likely to receive coverage by new media, so that families may be notified by the company beforehand, if possible
- Those involving collapse, cave-in, or other failure of structures or equipment

- Serious accidents involving equipment or vehicles

Work will be suspended to correct the cause of the incident and to modify this HSP if necessary.

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6.0 REFERENCES

Ahtna Engineering Services, Limited Liability Company (AES), *Injury and Illness Prevention Program Manual (IIPP)*, June 2010.

American Conference of Governmental Industrial Hygienists (ACGIH), *Threshold Limit Values (TLV) for Chemical Substances and Physical Agents and Biological Exposure Indices*, 2010.

National Institute for Occupational Safety and Health (NIOSH)/ Occupational Safety and Health Administration (OSHA)/United States (U.S.) Coast Guard (USCG)/U.S. Environmental Protection Agency (EPA), *Occupational Safety and Health Guidance Manual for Hazardous Waste Site Activities*, October 1985.

NIOSH, *Pocket Guide to Chemical Hazards*, September 2005.

U.S. Department of Labor OSHA, *29 Code of Federal Regulations (CFR) Title 29, Part 1910 – Occupational Safety and Health Standards*.

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FIGURE

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Figure 1

Hospital Location Map

APPENDIX A

ACKNOWLEDGEMENT FORM

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Site Health and Safety Plan Acknowledgement Form

Project Name: _____ **Project No.:**_____

This is to certify that I have read this Site Health and Safety Plan (HSP) and understand its contents. I have attended a site orientation and safety briefing discussing the elements of this HSP and the safety and health hazards associated with operations to be performed at this site. Failure to comply with the requirements contained in this HSP may result in my removal from the project.

PRINT NAME	SIGNATURE	DATE

APPENDIX B

MSDS / PADS

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MATERIAL SAFETY DATA SHEETS
127-18-4/E-2

DATE: 29Apr2011

SUPPLIER ADDRESS: Air Liquide
6141 EASTON RD
PO BOX 310
PLUMSTEADVILLE, PA 18949-0310

EMERGENCY PHONE NUMBER: (215) 766-8860

---

1. CHEMICAL PRODUCT

PRODUCT NAME: TETRACHLOROETHYLENE

SYNONYMS: Perchloroethylene, Ethylene tetrachloride

---

2. COMPOSITION, INFORMATION ON INGREDIENTS

Ingredient Name	Formula	CAS#	Concentration	Exposure Limits (PPM) ACGIH TLV	OSHA PEL	Other MAC	Other STEL
TETRACHLOROETHYLENE	C2CL4	127-18-4	99+%	25	100	35	100

---

3. HAZARD IDENTIFICATION

*** EMERGENCY OVERVIEW ***

Nonflammable liquid and vapor.
May cause irritation to the respiratory tract and skin.

POTENTIAL HEALTH EFFECTS

ROUTES OF ENTRY: Inhalation , Ingestion

ACUTE EFFECTS: Inhalation causes irritation of the respiratory tract. Symptoms include numbness, dizziness, incoordination, metallic taste, nausea, vomiting, vertigo, sinus inflammation, headache, anorexia, giddiness, inebriation, premature ventricular beats and unconsciousness. Skin and eye irritation may occur.

CHRONIC EFFECTS: Impaired memory, paralysis, nerve damage, liver and kidney damage, reproductive disorders, dermatitis and conjunctivitis. Suspected human

carcinogen.
MEDICAL CONDITIONS AGGRAVATED BY OVEREXPOSURE: None known
OTHER EFFECTS OF OVEREXPOSURE: None
CARCINOGENICITY (US Only):
NTP - Yes
IARC MONOGRAPHS - Yes
OSHA REGULATED - No

4. FIRST AID MEASURES

INHALATION: Immediately remove victim to fresh air. If breathing has stopped,
give artificial respiration. If breathing is difficult, give oxygen.
EYE CONTACT: Immediately flush with copious amounts of water for at least 15 minutes.
SKIN CONTACT: Immediately flush with copious amounts of water for at least 15 minutes while removing contaminated clothing.
INGESTION: Never give anything by mouth to an unconscious person. Have conscious and alert person drink 1 to 2 glasses of water. Do not induce vomiting because of aspiration hazard.
IN EVENT OF EXPOSURE, CONSULT A PHYSICIA
NOTE TO PHYSICIAN: None

5. FIRE FIGHTING MEASURES

FLASH POINT: Nonflammable
AUTOIGNITION TEMPERATURE: N/Ap
FLAMMABLE LIMITS: Nonflammable
LOWER:
UPPER:
EXTINGUISHING MEDIA: Use what is appropriate for surrounding fire.
SPECIAL FIRE FIGHTING INSTRUCTION AND EQUIPMENT: Wear self-contained breathing apparatus and full protective clothing. Keep fire exposed cylinders cool with water spray. If possible, stop the product flow.
HAZARDOUS COMBUSTION PRODUCTS: Toxic carbon monoxide and hydrogen chloride may be given off.
UNUSUAL FIRE AND EXPLOSION HAZARDS: Cylinder rupture may occur under fire conditions.

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6. ACCIDENTAL RELEASE MEASURES

CLEAN UP PROCEDURES: Evacuate and ventilate area. Shut off source if possible and remove source of heat. Absorb spills using a solid absorbant such as vermiculite.

SPECIALIZED EQUIPMENT: None

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7. HANDLING AND STORAGE

PRECAUTIONS TO BE TAKEN IN HANDLING: Secure cylinder when using to protect from falling. Use suitable hand truck to move cylinders. Intense UV light can decompose tetrachloroethylene to toxic and corrosive materials.

PRECAUTIONS TO BE TAKEN IN STORAGE:
Store in well ventilated areas. Store away from heat, flame, and sparks. Smoking, welding, open flame etc. should not be permitted in area of use or storage. Keep valve protection cap on cylinders when not in use.

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8. EXPOSURE CONTROLS/ PERSONAL PROTECTION

ENGINEERING CONTROLS: Provide adequate general and local exhaust ventilation to maintain concentration below exposure limits.

PERSONAL PROTECTION

EYE/FACE PROTECTION: Safety glasses
SKIN PROTECTION: Protective gloves.
RESPIRATORY PROTECTION: In case of leakage, use self-contained breathing apparatus.
OTHER PROTECTIVE EQUIPMENT: Safety shoes when handling cylinders.

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9. PHYSICAL AND CHEMICAL PROPERTIES

APPEARANCE: Colorless
ODOR: Sweet ether-like odor.
PHYSICAL STATE: Liquid
VAPOR PRESSURE: @22 deg.C: 15.8 mm Hg

VAPOR DENSITY (AIR=1): 5.8
BOILING POINT (C): 121
SOLUBILITY IN WATER: 0.04%
SPECIFIC GRAVITY (H2O=1): @20 deg.C:
1.623
EVAPORATION RATE: (CCl4=1): 0.27
ODOR THRESHOLD: 47 to 71ppm

10. STABILITY AND REACTIVITY

STABILITY: Stable under normal storage conditions.
CONDITIONS TO AVOID: Storage in poorly ventilated areas. Storage near a heat source.
MATERIALS TO AVOID: Lithium, barium, aluminum (powder), finely dispersed metals, dinitrogen tetroxide, sodium hydroxide, beryllium powder, hydrogen and nitric oxide.
HAZARDOUS POLYMERIZATION: Will not occur.
HAZARDOUS DECOMPOSITION: Hydrogen chloride and phosgene can be produced upon exposure to high temperature or from exposure to electric arcs. Toxic carbon monoxide.

11. TOXICOLOGICAL INFORMATION

LETHAL CONCENTRATION (LC50): 14,255 ppm, rat one hour.
LETHAL DOSE 50 (LD50): N/Ap
TERATOGENICITY: N/Ap
REPRODUCTIVE EFFECTS: N/Ap
MUTAGENICITY: N/Ap

12. ECOLOGICAL INFORMATION

No adverse ecological effects are expected.

13. DISPOSAL CONSIDERATIONS

WASTE DISPOSAL METHOD: Dispose of non-refillable cylinders in accordance with federal, state and local regulations. Allow gas to vent slowly to atmosphere in

an unconfined area or exhaust hood. If the cylinders are the refillable type,
return cylinders to supplier with any valve outlet plugs or caps secured and
valve protection caps in place.

14. TRANSPORT INFORMATION

CONCENTRATION: 99+%
DOT DESCRIPTION (US ONLY):
PROPER SHIPPING NAME:
Tetrachloroethylene
HAZARD CLASS: 6.1 (poison), Packing group III
IDENTIFICATION NUMBER: UN1897
REPORTABLE QUANTITIES: 100lbs
LABELING: KEEP AWAY FROM FOOOD
ADR/RID (EU Only): Class 6.1, 15(c)
SPECIAL PRECAUTIONS: Cylinders should be transported in a secure upright position in a well ventilated truck.

15. REGULATORY INFORMATION

OSHA: Process Safety Management: Material is not listed in appendix A of 29 CFR
1910.119 as highly hazardous chemical.
TSCA: Material is listed in TSCA inventory.
SARA: The threshold planning quantity for material is 10,000 lbs.
EU NUMBER: 204-825-9
NUMBER IN ANNEX 1 OF DIR 67/548: Not listed in annex 1.
EU CLASSIFICATION: N/Av
R: 40
S: 23, 36/37

16. OTHER INFORMATION

OTHER PRECAUTIONS: Protect containers from physical damage. Do not deface
cylinders or labels. Cylinders should be refilled by qualified producers of
compressed gas. Shipment of a compressed gas cylinder which has not been filled
by the owner or with his written consent is a violation of federal law (49 CFR).

ABBREVIATIONS:
N/Ap - Not Applicable
N/Av - Not Available
SA - Simple Asphyxiant
NE - None Established

MATERIAL SAFETY DATA SHEETS
79-01-6/E-3

DATE: 29Apr2011

SUPPLIER ADDRESS: Air Liquide
6141 EASTON RD
PO BOX 310
PLUMSTEADVILLE, PA 18949-0310

EMERGENCY PHONE NUMBER: (215) 766-8860

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1. CHEMICAL PRODUCT

PRODUCT NAME: TRICHLOROETHYLENE

SYNONYMS: Ethylene trichloride, Trichloroethene

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2. COMPOSITION, INFORMATION ON INGREDIENTS

Ingredient Name	Formula	CAS#	Concentration	Exposure Limits (PPM) TLV	OSHA PEL	Other MAC	Other STEL
TRICHLOROETHYLENE	C2HCl3	79-01-6	99+%	10	100	NE	25

Note: NE = NONE ESTABLISHED

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3. HAZARD IDENTIFICATION

*** EMERGENCY OVERVIEW ***

Poisonous, flammable liquid and vapor.
May be fatal if inhaled.
May cause heart, liver and kidney damage.
May cause irritation to the respiratory tract and skin.

POTENTIAL HEALTH EFFECTS

ROUTES OF ENTRY: Inhalation , Ingestion , Skin

ACUTE EFFECTS: Inhalation causes irritation of the respiratory tract. Symptoms include shortness of breath, headache, confusion, nausea, dizziness, and unconsciousness. Severe exposure may cause unconsciousness and death. Eye contact may cause irritation, redness, or blurred vision. Skin contact can cause defatting and dermatitis. Can be absorbed through the skin. Ingestion irritates

the digestive tract and may cause partial paralysis, unconsciousness and kidney
damage.
CHRONIC EFFECTS: Kidney and liver damage. Heart damage. Alteration of genetic
material. Suspected human carcinogen.
MEDICAL CONDITIONS AGGRAVATED BY OVEREXPOSURE: None known
OTHER EFFECTS OF OVEREXPOSURE: None
CARCINOGENICITY (US Only):
NTP - Yes
IARC MONOGRAPHS - Yes
OSHA REGULATED - No

4. FIRST AID MEASURES

INHALATION: Immediately remove victim to fresh air. If breathing has stopped,
give artificial respiration. If breathing is difficult, give oxygen.
EYE CONTACT: Immediately flush with copious amounts of water for at least 15 minutes.
SKIN CONTACT: Immediately flush with copious amounts of water for at least 15 minutes while removing contaminated clothing.
INGESTION: Never give anything by mouth to an unconscious person. Have conscious and alert person drink 1 to 2 glasses of water. Induce vomiting after victim drinks water.
IN EVENT OF EXPOSURE, CONSULT A PHYSICIA
NOTE TO PHYSICIAN: None

5. FIRE FIGHTING MEASURES

FLASH POINT: N/Av
AUTOIGNITION TEMPERATURE: 420 deg.C
FLAMMABLE LIMITS: Vol.% @ 25 deg.C
LOWER: 8
UPPER: 10.5
EXTINGUISHING MEDIA: Carbon dioxide, foam, or dry chemical.
SPECIAL FIRE FIGHTING INSTRUCTION AND EQUIPMENT: Wear self-contained breathing apparatus and full protective clothing. Keep fire exposed cylinders cool with water spray. If possible, stop the product flow.
HAZARDOUS COMBUSTION PRODUCTS: Toxic carbon monoxide, hydrogen chloride and

phosgene.
UNUSUAL FIRE AND EXPLOSION HAZARDS:
Emits toxic fumes under fire conditions.
Cylinder rupture may occur under fire
conditions.

6. ACCIDENTAL RELEASE MEASURES

CLEAN UP PROCEDURES: Remove leaking cylinder to exhaust hood or safe outdoor area if this can be done safely. Evacuate and ventilate area. Use a self-contained breathing apparatus in case of emergency or non-routine use. Shut off source if possible and remove source of heat. Absorb with sand or vermiculite and place in closed containers for disposal.
SPECIALIZED EQUIPMENT: None

7. HANDLING AND STORAGE

PRECAUTIONS TO BE TAKEN IN HANDLING: Secure cylinder when using to protect from falling. Use suitable hand truck to move cylinders. Use only in a well-ventilated area.
PRECAUTIONS TO BE TAKEN IN STORAGE:
Store in well ventilated areas. Keep
valve protection cap on cylinders when
not in use. Store away from heat, flame,
and sparks.

8. EXPOSURE CONTROLS/ PERSONAL PROTECTION

ENGINEERING CONTROLS: Provide adequate general and local exhaust ventilation to maintain concentrations below exposure and flammable limits.

PERSONAL PROTECTION

EYE/FACE PROTECTION: Goggles.
SKIN PROTECTION: Impervious gloves,
coveralls, boots, and/or other resistant
protective clothing.
RESPIRATORY PROTECTION: Use a
self-contained breathing apparatus in
case of emergency or non-routine use.
OTHER PROTECTIVE EQUIPMENT: Safety shoes
when handling cylinders.

9. PHYSICAL AND CHEMICAL PROPERTIES

APPEARANCE: Colorless
ODOR: Sweet ether-like odor.
PHYSICAL STATE: Liquid
VAPOR PRESSURE: @20 deg.C: 58 mm Hg
VAPOR DENSITY (AIR=1): 4.54
BOILING POINT (C): 87
SOLUBILITY IN WATER: @25 deg.C: 0.1%
SPECIFIC GRAVITY (H2O=1): @20 deg.C:
1.464
EVAPORATION RATE: (CCl4=1): 0.69
ODOR THRESHOLD: 82 to 108 ppm

10. STABILITY AND REACTIVITY

STABILITY: Stable under normal storage conditions.
CONDITIONS TO AVOID: Storage in poorly ventilated areas. Storage near a heat source. Exposure to light, moisture, and ignition sources.
MATERIALS TO AVOID: Powdered alkali or alkaline earth metals, strong oxidizing agents.
HAZARDOUS POLYMERIZATION: Will not occur.
HAZARDOUS DECOMPOSITION: HCl gas, phosgene gas, CO and oxides of chlorine.

11. TOXICOLOGICAL INFORMATION

LETHAL CONCENTRATION (LC50): NONE ESTABLISHED
LETHAL DOSE 50 (LD50): N/Ap
TERATOGENICITY: N/Ap
REPRODUCTIVE EFFECTS: N/Ap
MUTAGENICITY: N/Ap

12. ECOLOGICAL INFORMATION

No adverse ecological effects are expected.

13. DISPOSAL CONSIDERATIONS

WASTE DISPOSAL METHOD: Dispose of non-refillable cylinders in accordance with

federal, state and local regulations. Allow gas to vent slowly to atmosphere in an unconfined area or exhaust hood. If the cylinders are the refillable type, return cylinders to supplier with any valve outlet plugs or caps secured and valve protection caps in place. Waste can be burned in an approved incinerator equipped with an afterburner and scrubber.

14. TRANSPORT INFORMATION

CONCENTRATION: 99+%

DOT DESCRIPTION (US ONLY):

PROPER SHIPPING NAME: Trichloroethylene

HAZARD CLASS: 6.1 (poison), Packing group III

IDENTIFICATION NUMBER: UN1710

REPORTABLE QUANTITIES: 100 lb.

LABELING: KEEP AWAY FROM FOOD

ADR/RID (EU Only): Class 6.1, 15(c)

SPECIAL PRECAUTIONS: Cylinders should be transported in a secure upright position in a well ventilated truck.

15. REGULATORY INFORMATION

OSHA: Process Safety Management: Material is not listed in appendix A of 29 CFR 1910.119 as highly hazardous chemical.

TSCA: Material is listed in TSCA inventory.

SARA: The threshold planning quantity for material is 10,000 lbs.

EU NUMBER: 201-167-4

NUMBER IN ANNEX 1 OF DIR 67/548: Material is listed in annex 1.

EU CLASSIFICATION: N/Av

R: 40

S: 23-36/37

16. OTHER INFORMATION

OTHER PRECAUTIONS: Protect containers from physical damage. Do not deface cylinders or labels. Cylinders should be refilled by qualified producers of

compressed gas. Shipment of a compressed gas cylinder which has not been filled by the owner or with his written consent is a violation of federal law (49 CFR).

ABBREVIATIONS:
N/Ap - Not Applicable
N/Av - Not Available
SA - Simple Asphyxiant
NE - None Established

MATERIAL SAFETY DATA SHEETS
156-59-2/E-1

DATE: 29Apr2011

SUPPLIER ADDRESS: 6141 EASTON RD
PO BOX 310
PLUMSTEADVILLE, PA 18949-0310

EMERGENCY PHONE NUMBER: (215) 766-8860

1. CHEMICAL PRODUCT

PRODUCT NAME: 1,2-DICHLOROETHYLENE (CIS)

SYNONYMS: cis-Dichloroethylene

2. COMPOSITION, INFORMATION ON INGREDIENTS

Ingredient Name	Formula	CAS#	Concentration	Exposure Limits (PPM) TLV	OSHA PEL	Other ACGIH MAC	STEL
1,2-DICHLOROETHYLENE (CIS	C2H2CL2	156-59-2	99+%	200	NE	NE	NE

Note: NE = NONE ESTABLISHED

3. HAZARD IDENTIFICATION

*** EMERGENCY OVERVIEW ***

Flammable liquid and vapor.
Can form explosive mixtures with air.
Can cause irritation to eyes, skin and respiratory tract.

POTENTIAL HEALTH EFFECTS
ROUTES OF ENTRY: Inhalation , Ingestion
ACUTE EFFECTS: Vapor or mist is irritating to the eyes, skin, mucous membrane, and upper respiratory tract. Skin and eye irritation may occur. High concentrations may have a narcotic effect.
CHRONIC EFFECTS: Kidney and liver damage.
MEDICAL CONDITIONS AGGRAVATED BY OVEREXPOSURE: None known
OTHER EFFECTS OF OVEREXPOSURE: None
CARCINOGENICITY (US Only):
NTP - No
IARC MONOGRAPHS - No
OSHA REGULATED - No

4. FIRST AID MEASURES

INHALATION: Immediately remove victim to fresh air. If breathing has stopped, give artificial respiration. If breathing is difficult, give oxygen.

EYE CONTACT: Immediately flush with copious amounts of water for at least 15 minutes.

SKIN CONTACT: Immediately flush with copious amounts of water for at least 15 minutes while removing contaminated clothing.

INGESTION: Never give anything by mouth to an unconscious person. Have conscious and alert person drink 1 to 2 glasses of water. Induce vomiting after victim drinks water.

IN EVENT OF EXPOSURE, CONSULT A PHYSICIA

NOTE TO PHYSICIAN: None

5. FIRE FIGHTING MEASURES

FLASH POINT: 2 deg.C

AUTOIGNITION TEMPERATURE: 460 deg. C

FLAMMABLE LIMITS: Vol.%

LOWER: 5.6

UPPER: 12.80

EXTINGUISHING MEDIA: Carbon dioxide, foam, or dry chemical.

SPECIAL FIRE FIGHTING INSTRUCTION AND EQUIPMENT: Wear self-contained breathing apparatus and full protective clothing. Keep fire exposed cylinders cool with water spray.

HAZARDOUS COMBUSTION PRODUCTS: Toxic carbon monoxide, hydrogen chloride and phosgene.

UNUSUAL FIRE AND EXPLOSION HAZARDS: Cylinder rupture may occur under fire conditions. Emits toxic fumes under fire conditions. Vapors may travel a considerable distance to the source of ignition and flash back.

6. ACCIDENTAL RELEASE MEASURES

CLEAN UP PROCEDURES: Evacuate and ventilate area. Remove leaking cylinder to

exhaust hood or safe outdoor area. Shut off source if possible and remove source of heat. Absorb with sand or vermiculite and place in closed containers for disposal.

SPECIALIZED EQUIPMENT: None

7. HANDLING AND STORAGE

PRECAUTIONS TO BE TAKEN IN HANDLING: Secure cylinder when using to protect from falling. Use suitable hand truck to move cylinders. Use only in a well-ventilated area.

PRECAUTIONS TO BE TAKEN IN STORAGE:
Store in well ventilated areas. Keep valve protection cap on cylinders when not in use. Store away from oxidizers, combustible materials, and source of ignition or heat.

8. EXPOSURE CONTROLS/ PERSONAL PROTECTION

ENGINEERING CONTROLS: Provide adequate general and local exhaust ventilation to maintain concentrations below exposure and flammable limits.

PERSONAL PROTECTION

EYE/FACE PROTECTION: Goggles. A safety shower and eyewash station should be readily available.
SKIN PROTECTION: Wear suitable protective clothing.
RESPIRATORY PROTECTION: Use a self-contained breathing apparatus in case of emergency or non-routine use.
OTHER PROTECTIVE EQUIPMENT: Safety shoes when handling cylinders.

9. PHYSICAL AND CHEMICAL PROPERTIES

APPEARANCE: Colorless
ODOR: Pleasant aromatic odor
PHYSICAL STATE: Liquid
VAPOR PRESSURE: @41 deg.C: 400 mm Hg
VAPOR DENSITY (AIR=1): 3.34
BOILING POINT (C): 59
SOLUBILITY IN WATER: Insoluble
SPECIFIC GRAVITY (H2O=1): @20 deg.C:

1.284
EVAPORATION RATE: N/Av
ODOR THRESHOLD: N/Av

10. STABILITY AND REACTIVITY

STABILITY: Stable under normal storage conditions.
CONDITIONS TO AVOID: Storage in poorly ventilated areas. Storage near a heat source.
MATERIALS TO AVOID: Oxidizing agents, air and moisture. Nitrogen dioxide, sodium, potassium hydroxide.
HAZARDOUS POLYMERIZATION: Will not occur.
HAZARDOUS DECOMPOSITION: HCl gas, phosgene gas, CO and oxides of chlorine.

11. TOXICOLOGICAL INFORMATION

LETHAL CONCENTRATION (LC50): None established
LETHAL DOSE 50 (LD50): N/Ap
TERATOGENICITY: N/Ap
REPRODUCTIVE EFFECTS: N/Ap
MUTAGENICITY: N/Ap

12. ECOLOGICAL INFORMATION

No adverse ecological effects are expected.

13. DISPOSAL CONSIDERATIONS

WASTE DISPOSAL METHOD: Dispose of non-refillable cylinders in accordance with federal, state and local regulations. Allow gas to vent slowly to atmosphere in an unconfined area or exhaust hood. If the cylinders are the refillable type, return cylinders to supplier with any valve outlet plugs or caps secured and valve protection caps in place. Waste can be burned in an approved incinerator equipped with an afterburner and scrubber.

14. TRANSPORT INFORMATION

CONCENTRATION: 99+%
DOT DESCRIPTION (US ONLY):
PROPER SHIPPING NAME: Flammable liquids, n.o.s.
HAZARD CLASS: 3 (flammable), Packing Group I
IDENTIFICATION NUMBER: UN1993
REPORTABLE QUANTITIES: 1000 lb.
LABELING: FLAMMABLE LIQUID
ADR/RID (EU Only): Class 3, 3(b)
SPECIAL PRECAUTIONS: Cylinders should be transported in a secure upright position in a well ventilated truck.

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15. REGULATORY INFORMATION

OSHA: Process Safety Management: Material is not listed in appendix A of 29 CFR 1910.119 as highly hazardous chemical.
TSCA: Material is listed in TSCA inventory.
SARA: The threshold planning quantity for material is 10,000 lbs.
EU NUMBER: N/Av
NUMBER IN ANNEX 1 OF DIR 67/548: Material is listed in annex 1.
EU CLASSIFICATION: N/Av
R: 22-33-35-64
S: 15-22-23-27-36-65-71-76-104

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16. OTHER INFORMATION

OTHER PRECAUTIONS: Protect containers from physical damage. Do not deface cylinders or labels. Cylinders should be refilled by qualified producers of compressed gas. Shipment of a compressed gas cylinder which has not been filled by the owner or with his written consent is a violation of federal law (49 CFR).

ABBREVIATIONS:
N/Ap - Not Applicable
N/Av - Not Available
SA - Simple Asphyxiant
NE - None Established

DISCLAIMER: Information included in this document is given to the best of our knowledge, however, no warranty is made

MATERIAL SAFETY DATA SHEETS
156-60-5/E-1

DATE: 29Apr2011

SUPPLIER ADDRESS: 6141 EASTON RD
PO BOX 310
PLUMSTEADVILLE, PA 18949-0310
EMERGENCY PHONE NUMBER: (215) 766-8860

1. CHEMICAL PRODUCT

PRODUCT NAME: 1,2-DICHLOROETHYLENE (TRANS)
SYNONYMS: trans-Acetylene dichloride.

2. COMPOSITION, INFORMATION ON INGREDIENTS

Ingredient Name	Formula	CAS#	Concentration	Exposure Limits (PPM) TLV	OSHA PEL	ACGIH MAC	Other STEL
1,2-DICHLOROETHYLENE (TRA	C2H2CL2	156-60-5	99+%	200	200	200	NE

Note: NE = NONE ESTABLISHED

3. HAZARD IDENTIFICATION

*** EMERGENCY OVERVIEW ***
Flammable liquid and vapor.
May cause irritation to eyes, skin, and mucous membranes.

POTENTIAL HEALTH EFFECTS
ROUTES OF ENTRY: Inhalation
ACUTE EFFECTS: Vapor or mist is irritating to the eyes, skin, mucous membranes, and upper respiratory tract. This material is narcotic in high concentrations.
CHRONIC EFFECTS: None known
MEDICAL CONDITIONS AGGRAVATED BY OVEREXPOSURE: None known
OTHER EFFECTS OF OVEREXPOSURE: None
CARCINOGENICITY (US Only):
NTP - No
IARC MONOGRAPHS - No
OSHA REGULATED - No

4. FIRST AID MEASURES

INHALATION: Immediately remove victim to fresh air. If breathing is difficult, give oxygen. If breathing has stopped, give artificial respiration.

EYE CONTACT: Immediately flush with copious amounts of water for at least 15 minutes.

SKIN CONTACT: Immediately flush with copious amounts of water for at least 15 minutes while removing contaminated clothing.

INGESTION: Never give anything by mouth to an unconscious person. Contact a poison control center.

IN EVENT OF EXPOSURE, CONSULT A PHYSICIA

NOTE TO PHYSICIAN: None

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5. FIRE FIGHTING MEASURES

FLASH POINT: 19.8 deg. C

AUTOIGNITION TEMPERATURE: N/Av

FLAMMABLE LIMITS:

LOWER: 9.7

UPPER: 12.8

EXTINGUISHING MEDIA: Dry chemical powder, carbon dioxide, or alcohol or polymer foam. Water spray.

SPECIAL FIRE FIGHTING INSTRUCTION AND EQUIPMENT: Wear self-contained breathing apparatus and full protective clothing. Keep fire exposed cylinders cool with water spray.

HAZARDOUS COMBUSTION PRODUCTS: Toxic carbon monoxide, hydrogen chloride and phosgene.

UNUSUAL FIRE AND EXPLOSION HAZARDS: Emits toxic fumes under fire conditions. Vapors may travel a considerable distance to the source of ignition and flash back.

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6. ACCIDENTAL RELEASE MEASURES

CLEAN UP PROCEDURES: Evacuate and ventilate area. Remove all sources of ignition. Absorb with sand or vermiculite and place in closed containers for disposal.

SPECIALIZED EQUIPMENT: None

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7. HANDLING AND STORAGE

PRECAUTIONS TO BE TAKEN IN HANDLING: Secure cylinder when using to protect from falling. Use suitable hand truck to move cylinders.

PRECAUTIONS TO BE TAKEN IN STORAGE:
Store in well ventilated areas. Keep valve protection cap on cylinders when not in use.

---

8. EXPOSURE CONTROLS/ PERSONAL PROTECTION

ENGINEERING CONTROLS: Provide adequate general and local exhaust ventilation to maintain concentrations below exposure and flammable limits.

PERSONAL PROTECTION

EYE/FACE PROTECTION: Goggles. A safety shower and eyewash station should be readily available.
SKIN PROTECTION: Wear suitable protective clothing.
RESPIRATORY PROTECTION: Use a self-contained breathing apparatus in case of emergency or non-routine use.
OTHER PROTECTIVE EQUIPMENT: Safety shoes when handling cylinders.

---

9. PHYSICAL AND CHEMICAL PROPERTIES

APPEARANCE: Colorless
ODOR: Pleasant aromatic odor
PHYSICAL STATE: Liquid
VAPOR PRESSURE: @20 deg. C: 295 mm Hg
VAPOR DENSITY (AIR=1): 3.3
BOILING POINT (C): 48
SOLUBILITY IN WATER: Insoluble
SPECIFIC GRAVITY (H2O=1): 1.257
EVAPORATION RATE: N/Av
ODOR THRESHOLD: N/Av

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10. STABILITY AND REACTIVITY

STABILITY: Stable under normal storage conditions.
CONDITIONS TO AVOID: Sparks, flame, heat

and other sources of ignition.
MATERIALS TO AVOID: Oxidizing agents.
HAZARDOUS POLYMERIZATION: Will not occur.
HAZARDOUS DECOMPOSITION: HCl gas, phosgene gas, CO and oxides of chlorine.

11. TOXICOLOGICAL INFORMATION

LETHAL CONCENTRATION (LC50): NONE ESTABLISHED
LETHAL DOSE 50 (LD50): N/Ap
TERATOGENICITY: N/Ap
REPRODUCTIVE EFFECTS: N/Ap
MUTAGENICITY: N/Ap

12. ECOLOGICAL INFORMATION

No adverse ecological effects are expected.

13. DISPOSAL CONSIDERATIONS

WASTE DISPOSAL METHOD: Dispose of non-refillable cylinders in accordance with federal, state and local regulations. Allow gas to vent slowly to atmosphere in an unconfined area or exhaust hood. If the cylinders are the refillable type, return cylinders to supplier with any valve outlet plugs or caps secured and valve protection caps in place. Waste can be burned in an approved incinerator equipped with an afterburner and scrubber.

14. TRANSPORT INFORMATION

CONCENTRATION: 99+%
DOT DESCRIPTION (US ONLY):
PROPER SHIPPING NAME: Dichloroethylene
HAZARD CLASS: 3 (flammable), Packing group II.
IDENTIFICATION NUMBER: UN1150
REPORTABLE QUANTITIES: 1000 lbs
LABELING: FLAMMABLE LIQUID
ADR/RID (EU Only): Class 3, 3(b)
SPECIAL PRECAUTIONS: Cylinders should be transported in a secure upright position

in a well ventilated truck.

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15. REGULATORY INFORMATION

OSHA: Process Safety Management: Material is not listed in appendix A of 29 CFR 1910.119 as highly hazardous chemical.

TSCA: Material is listed in TSCA inventory.

SARA: The threshold planning quantity for material is 10,000 lbs.

EU NUMBER: N/Av

NUMBER IN ANNEX 1 OF DIR 67/548: Not listed in annex 1.

EU CLASSIFICATION: N/Av

R: N/Av

S: N/Av

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16. OTHER INFORMATION

OTHER PRECAUTIONS: Protect containers from physical damage. Do not deface cylinders or labels. Cylinders should be refilled by qualified producers of compressed gas. Shipment of a compressed gas cylinder which has not been filled by the owner or with his written consent is a violation of federal law (49 CFR).

ABBREVIATIONS:

N/Ap - Not Applicable

N/Av - Not Available

SA - Simple Asphyxiant

NE - None Established

DISCLAIMER: Information included in this document is given to the best of our knowledge, however, no warranty is made that the information is accurate or complete. We do not accept any responsibility for damages by the use of the document.

MATERIAL SAFETY DATA SHEETS
75-01-4/E-5

DATE: 29Apr2011

SUPPLIER ADDRESS: 6141 EASTON RD
PO BOX 310
PLUMSTEADVILLE, PA 18949-0310
EMERGENCY PHONE NUMBER: (215) 766-8860

1. CHEMICAL PRODUCT

PRODUCT NAME: VINYL CHLORIDE

SYNONYMS: VCM, Chloroethylene, chloroethane

2. COMPOSITION, INFORMATION ON INGREDIENTS

Ingredient Name	Formula	CAS#	Concentration	Exposure Limits (PPM) ACGIH TLV	OSHA PEL	Other MAC	Other STEL
VINYL CHLORIDE	C2H3Cl	75-01-4	99+%	5	1	NE	5

Note: NE = NONE ESTABLISHED

3. HAZARD IDENTIFICATION

*** EMERGENCY OVERVIEW ***

Flammable liquid and gas under pressure.
Can cause cancer.
Can form explosive mixtures with air.
May cause liver, kidney, spleen, and other organ damage.
May cause irritation to eyes, skin and mucous membranes.
May cause frostbite.

POTENTIAL HEALTH EFFECTS

ROUTES OF ENTRY: Inhalation

ACUTE EFFECTS: Vapor inhalation causes varying degrees of central nervous system depression with noticeable anesthetic effects at levels of 1% (10,000 ppm). Inhalation can cause headache, dizziness, lung irritation, narcosis and unconsciousness. Pressure drop through valves and piping may cause extreme cold and frostbite on contact.

CHRONIC EFFECTS: Liver tumors (angiosarcomas) are formed from vinyl chloride exposure. Other tumors of the central nervous system, respiratory system, blood and lumphatic system occured from exposure to the polyvinyl chloride manufacture process but vinyl chloride itself may not be the causative agent.
MEDICAL CONDITIONS AGGRAVATED BY OVEREXPOSURE: None known
OTHER EFFECTS OF OVEREXPOSURE: None
CARCINOGENICITY (US Only):
NTP - Yes
IARC MONOGRAPHS - Yes
OSHA REGULATED - Yes

4. FIRST AID MEASURES

INHALATION: Immediately remove victim to fresh air. If breathing has stopped, give artificial respiration. If breathing is difficult, give oxygen.
EYE CONTACT: Immediately flush with copious amounts of water for at least 15 minutes.
SKIN CONTACT: If frostbite occurs, flush affected areas with lukewarm water.
INGESTION: None
IN EVENT OF EXPOSURE, CONSULT A PHYSICIA
NOTE TO PHYSICIAN: None

5. FIRE FIGHTING MEASURES

FLASH POINT: -78 deg. C
AUTOIGNITION TEMPERATURE: 472 deg. C
FLAMMABLE LIMITS: Vol.%
LOWER: 3.6
UPPER: 33
EXTINGUISHING MEDIA: Dry chemical, carbon dioxide, or halogenated gas.
SPECIAL FIRE FIGHTING INSTRUCTION AND EQUIPMENT: Wear self-contained breathing apparatus and full protective clothing. Keep fire exposed cylinders cool with water spray.
HAZARDOUS COMBUSTION PRODUCTS: Toxic carbon monoxide and hydrogen chloride may be given off.
UNUSUAL FIRE AND EXPLOSION HAZARDS: Cylinder rupture may occur under fire conditions. May form explosive mixture in air.

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6. ACCIDENTAL RELEASE MEASURES

CLEAN UP PROCEDURES: Evacuate and ventilate area. Shut off source if possible and remove source of heat.

SPECIALIZED EQUIPMENT: None

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7. HANDLING AND STORAGE

PRECAUTIONS TO BE TAKEN IN HANDLING: Secure cylinder when using to protect from falling. Use suitable hand truck to move cylinders.

PRECAUTIONS TO BE TAKEN IN STORAGE:
Store in well ventilated areas. Keep valve protection cap on cylinders when not in use.

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8. EXPOSURE CONTROLS/ PERSONAL PROTECTION

ENGINEERING CONTROLS: Provide adequate general and local exhaust ventilation to maintain concentrations below exposure and flammable limits.

PERSONAL PROTECTION

EYE/FACE PROTECTION: Safety glasses

SKIN PROTECTION: None

RESPIRATORY PROTECTION: In case of leakage, use self-contained breathing apparatus.

OTHER PROTECTIVE EQUIPMENT: Safety shoes when handling cylinders.

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9. PHYSICAL AND CHEMICAL PROPERTIES

APPEARANCE: Colorless

ODOR: Sweet odor.

PHYSICAL STATE: Gas

VAPOR PRESSURE: @20 deg.C: 2530 mm Hg

VAPOR DENSITY (AIR=1): 2.2

BOILING POINT (C): -13.9

SOLUBILITY IN WATER: Slight

SPECIFIC GRAVITY (H2O=1): @20 deg.C: 0.9106

EVAPORATION RATE: Gas

ODOR THRESHOLD: 2000 ppm

10. STABILITY AND REACTIVITY

STABILITY: Stable under normal storage conditions.
CONDITIONS TO AVOID: Storage in poorly ventilated areas. Storage near a heat source. Exposure to air, heat, light and moisture.
MATERIALS TO AVOID: Copper, aluminum and certain catalytic impurities. It can form peroxides by catalyzed oxidation with atmospheric oxygen. Oxidizing agents.
HAZARDOUS POLYMERIZATION: May occur.
HAZARDOUS DECOMPOSITION: Toxic carbon monoxide and hydrogen chloride.

11. TOXICOLOGICAL INFORMATION

LETHAL CONCENTRATION (LC50): >5000 ppm, Rat 1 hour
LETHAL DOSE 50 (LD50): N/Ap
TERATOGENICITY: N/Ap
REPRODUCTIVE EFFECTS: N/Ap
MUTAGENICITY: N/Ap

12. ECOLOGICAL INFORMATION

No adverse ecological effects are expected.

13. DISPOSAL CONSIDERATIONS

WASTE DISPOSAL METHOD: Dispose of non-refillable cylinders in accordance with federal, state and local regulations. Allow gas to vent slowly to atmosphere in an unconfined area or exhaust hood. If the cylinders are the refillable type, return cylinders to supplier with any valve outlet plugs or caps secured and valve protection caps in place. Waste can be burned in an approved incinerator equipped with an afterburner and scrubber.

14. TRANSPORT INFORMATION

CONCENTRATION: 99+%
DOT DESCRIPTION (US ONLY):
PROPER SHIPPING NAME: Vinyl chloride, inhibited
HAZARD CLASS: 2.1 (flammable)
IDENTIFICATION NUMBER: UN1086
REPORTABLE QUANTITIES: 1 lb.
LABELING: FLAMMABLE GAS
ADR/RID (EU Only): Class 2, 2F
SPECIAL PRECAUTIONS: Cylinders should be transported in a secure upright position in a well ventilated truck.

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15. REGULATORY INFORMATION

OSHA: Process Safety Management: Material is not listed in appendix A of 29 CFR 1910.119 as highly hazardous chemical.
TSCA: Material is listed in TSCA inventory.
SARA: The threshold planning quantity for material is 10,000 lbs.
EU NUMBER: 200-831-0
NUMBER IN ANNEX 1 OF DIR 67/548: Not listed in annex 1.
EU CLASSIFICATION: N/Av
R: 45,13
S: 53,9,16,44

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16. OTHER INFORMATION

OTHER PRECAUTIONS: Protect containers from physical damage. Do not deface cylinders or labels. Cylinders should be refilled by qualified producers of compressed gas. Shipment of a compressed gas cylinder which has not been filled by the owner or with his written consent is a violation of federal law (49 CFR).
ABBREVIATIONS:
N/Ap - Not Applicable
N/Av - Not Available
SA - Simple Asphyxiant
NE - None Established
DISCLAIMER: Information included in this document is given to the best of our knowledge, however, no warranty is made that the information is accurate or

Physical Agent Data Sheet (PADS)

Noise

Description

Sound is created when a vibrating source (like a bell, motor or a stereo speaker) sends sound waves through the air to your ear. Every sound has two aspects: its pitch (frequency) and its loudness (intensity). On a stereo, frequency is determined by the bass/treble control. Intensity is determined by the volume control. Noise (unwanted sound) is usually made up of many frequencies. The disturbing and harmful effects of noise depend both on the loudness and the frequency of the tones making up noise.

Loudness is measured in units called decibels (dB). A conversational voice is about 65 dB. A shout is 90 dB or greater.

Frequency is measured in units called Hertz (Hz). The frequency of a locomotive horn is about 250 Hz. The frequency of a table saw is about 4,000 Hz.

Health Effects

Excessive noise can destroy the ability to hear, and may also put stress of other parts of the body, including the heart.

For most effects of noise, there is no cure, so that prevention of excessive noise exposure is the only way to avoid health damage.

Hearing

The damage done by noise depends mainly on how loud it is and on the length of exposure. The frequency or pitch can also have some effect, since high-pitched sounds are more damaging than low-pitched sounds.

Noise may tire out the inner ear, causing temporary hearing loss. After a period of time away from the noise hearing may be restored. Some workers who suffer temporary hearing loss may find that by the time their hearing returns to normal, it is time for another work shift so, in that sense, the problem is "permanent."

With continual noise exposure, the ear will lose its ability to recover from temporary hearing loss, and the damage will become permanent. Permanent hearing loss results from the destruction of cells in the inner ear, cells which can never be replaced or repaired. Such damage can be caused by long-term exposure to loud noise or, in some cases" by brief exposures to very loud noises.

Normally, workplace noise first affects the ability to hear high frequency (high-pitched) sounds. This means that even though a person can still hear some noise, speech or other sounds may be unclear or distorted.

Workers suffering from noise-induced hearing loss may also experience continual ringing in their ears,

called "tinnitus." At this time, there is no cure for tinnitus, although some doctors are experimenting with treatment.

Other Effects

Although research on the effects of noise is not complete, it appears that noise can cause quickened pulse rate, increased blood pressure and a narrowing of the blood vessels over a long period of time, these may place an added burden on the heart.

Noise may also put stress on other parts of the body by causing the abnormal secretion of hormones and tensing of the muscles.

Workers exposed to noise sometimes complain of nervousness, sleeplessness and fatigue. Excessive noise exposure also can reduce job performance and may cause high rates of absenteeism.

Permissible Exposure Limit

The Action level for noise is an average noise level of 85 dB for an eight-hour day. When employees are exposed to noise levels, which exceed the Permissible Exposure Limit, the employer must install or use engineering or administrative controls to lower the noise levels. While these controls are being designed or installed employees must wear hearing protection. If the controls still do not reduce noise exposures to below 90 dB, hearing protection must continue to be worn.

Protective Measures

Suitable hearing protectors (earplugs or muffs) must be made available at no cost to employees who are exposed to an average of 85 dB or greater for an eight-hour day. Employees must be given the opportunity to select from three different types of appropriate hearing protectors.

Hearing tests (audiometric exams) must be given to employees who are exposed to an average of 85 dB or greater for an eight-hour day. Hearing tests will show whether employees are experiencing any hearing losses. Hearing tests are also useful in showing how well the earplugs and earmuffs are working. Hearing tests must be given annually.

Employees should also receive training in the effects of noise on hearing, an explanation of the hearing tests, and instruction on the proper fitting and care of earplugs or muffs.

Noise away from work can also cause hearing loss. Hearing protectors should be worn when operating noisy equipment or tools such as chain saws, brush cutters, power lawn mowers, or when using firearms.

Refer to Alaska Administrative Code, Occupational Health and Environmental Control 04.0104 for specific regulations on Noise Exposure and Hearing Conservation Programs.

Physical Agent Data Sheet (PADS)

Cold Stress

Exposure to cold can cause the body's internal temperature to drop to a dangerously low level. This is called hypothermia. Exposure to temperatures below freezing can cause frostbite of the hands, feet, and face.

Hypothermia Can Kill

Hypothermia occurs when a person's body loses heat faster than it can be produced. The body's "normal" deep body temperature is 99.6 degrees Fahrenheit. . If your body temperature drops to 95 degrees Fahrenheit, uncontrollable shivering occurs. If cooling continues, these other symptoms may occur:

Vague, slow, slurred speech

Forgetfulness, memory lapses

Inability to use hands

Frequent stumbling

Drowsiness

Exhaustion, collapse

Unconsciousness

Death

Hypothermia impairs your judgment. You may not be able to make good decisions about your situation. Preventing hypothermia is the best way to avoid being a victim.

Preventing Hypothermia: Be Prepared

Hypothermia can occur at temperatures above freezing. Cold, wet, windy conditions make prime hypothermia weather.

Stay Dry - Avoid Exposure

Wet clothing draws heat very quickly away from the body. Whenever you may be away from shelter or your vehicle, carry waterproof, windproof outer clothing. Put this clothing on before you get wet. Wear inner clothing which retains warmth even when it's wet, such as wool or polypropylene. Avoid cotton clothing. Down clothing is good for cold, dry weather but it loses almost all insulating value if it gets wet. Wear layers of clothing which may be removed or put back on depending on the degree of physical activity. Being wet from sweat is just as dangerous as being wet from rain or snow.

Terminate Exposure

If you do not have adequate clothing to stay warm and dry, get out of the wind and rain or snow. Return to shelter or make camp while you still have a reserve of energy. Build a fire. Make your camp as secure and as comfortable as possible.

Treatment of Hypothermia

Be able to recognize the symptoms of hypothermia in yourself and others. The victim may deny he/she is in trouble. Even mild symptoms demand attention.

1. Get the victim out of wet and windy weather.
2. Remove all wet clothing.
3. If the person is only mildly affected:

    a. Give warm drinks

    b. Put into dry clothing and a warm sleeping bag.

If more seriously affected (very clumsy, confused, unable to shiver):

1. Treat very gently.
2. Place the victim naked into a warm sleeping bag.
3. Place a rescuer, also naked, into the same sleeping bag. If you have a double bag, place the victim between two rescuers. Warmth from skin to skin contact is the safest method of rewarming. Any warm objects such as rocks, hot water bottles, or heat packs should be wrapped in towels or clothing. Arrange for evacuation. Do not give warm drinks until the victim has regained a clear level of consciousness, the ability to swallow, and is already starting to warm up.

Frostbite[1]

Frostbite is the freezing of some part of the body. Fingers, toes, and even whole arms and legs can be lost as a result of frostbite. Such injuries have happened in cities and villages as well as in more isolated areas of Alaska.

Protection From the Cold

In extreme cold it is important to prevent heat loss from as many areas of the body as possible. Exposed limbs and head are major areas of heat loss, but keeping enough blood flowing to the hands and feet is the key to preventing frostbite. The trunk and the head, then, should be warm enough so that the brain is able to command the blood vessels in the hands and feet to open up.

Essential Clothing

This includes thermal underwear, insulated footwear or mukluks with liners, double mittens and a parka, preferably down-filled with a good ruff. A parka which can be opened at the neck to allow heat to escape will prevent overheating and sweating. Quilted or skin pants are necessary if no warm shelter is immediately available. Tight clothes, especially tight gloves or tight boots, should not be worn. They interfere with the blood flow and reduce insulation against the cold.

Traveling

The traveler, even on a snowmobile, or in a heated automobile, should always be prepared to walk in severe cold. This means carrying along proper clothing and more extensive survival gear. If an accident, mechanical breakdown, or other interruption occurs during travel, the clothes you have must provide enough warmth to sustain life. Hands and feet should be well protected at all times to hinder the development of frostbite until help arrives.

Some Special Warnings

Don't touch cold metal with bare or wet hands. You will freeze to the metal and tear away skin. If necessary, thaw gently with heat, warm water or urine.

Be careful when handling gasoline, kerosene or liquids other than water. Contact at cold temperatures can cause immediate frostbite.

Remember that frostbite is more likely to occur when you are injured, frightened or careless.

Other Factors Leading to Frostbite

Tall thin persons are more likely to get frostbite than those of stocky build.

People in poor physical condition are more susceptible than those in good health.

Certain diseases slow down the blood flow in the hands and feet, especially in elderly people, and encourage frostbite.

Heavy smokers often have poor circulation in the vital organs and to the arms and legs, and are also susceptible.

Children and elderly people, unable to produce large amounts of body heat for long periods of time, may experience a lowering of deep body temperature and, ultimately, frostbite.

Alcohol causes the blood vessels to dilate (become larger). This lends a sense of warmth, but it also insures a faster loss of body heat. More important, people act with poor judgement after drinking.

In short, poor circulation and poor production of body heat will lower resistance to frostbite.

How to Recognize Frostbite

Pain in the hands and feet is felt only when the temperature of the tissue is changing very rapidly. There may be no pain with gradual freezing.

Loss of the sensations of touch, pressure, and pain may occur without awareness of any numbness or other sensation. Therefore, it is important to test these sensations often and to wear clothing that is loose and does not restrict the flow of blood to the limbs.

Exposed parts of the body should be inspected routinely. This is done best by a partner. Just before freezing, the skin, especially the face with its many blood vessels, becomes bright red. Then small patches of white appear, as freezing actually occurs.

The skin also becomes less elastic. This is best noted in the finger pads, which remain pitted when touched or squeezed. Any further cooling will surely result in frostbite.

Serious freezing is most common in the feet because of less awareness of them, poor circulation and sensation, and inadequate foot gear. Hands are next in order of serious injury. Exposed head parts are less likely to become frostbitten than feet because they are conditioned to exposure and have a better blood supply.

Early Treatment of Frostbite: Proper Rewarming

1. Next to the extent of freezing, inadequate or improper treatment of a frozen part is the most common cause of serious loss of tissue.
2. In many cases rewarming cannot be done without the part again becoming frozen. For example, removing clothing from other parts of the body to warm a frozen part may only result in the loss of more body heat, greater extent of injury, and the ultimate refreezing of the afflicted part.

   Thawing and refreezing should aways be avoided. It is best to continue, even if it means walking on a frozen foot, until shelter is available and rewarming can be. done satisfactorily.
3. Limbs should be rewarmed in stirred water just above normal body temperature (about 100 - 105 degrees Fahrenheit). Using a thermometer is the only accurate way to measure this temperature. Never try to thaw in cold water or snow. Since feeling is lost, fires, stoves, exhaust pipes, etc., should never be used. Serious damage to the tissue could result.
4. If the major part of the limb is frozen when rewarming is started, deep body temperature will fall as the cooled blood begins to flow throughout the body. To prevent such cooling, warm liquids by mouth should be given. Even total immersion of the body in a warm bath may be necessary.
5. Rewarming is an acutely painful experience and medication to alleviate pain should be given if available. After thawing, a deep aching pain may persist for several days, depending upon severity of the injury. Pain is actually a good sign, since it indicates that nerve function is still present.
6. The afflicted part should be moved gently and voluntarily during rewarming.
7. A dull purple color indicates more serious injury and requires medical attention. So does swelling or blisters. Other means for improving circulation are available but must be administered by medical personnel.

Summary

Most cases of frostbite occur as a result of lack of knowledge, careless preparation, unavoidable accident, or the effects of alcohol on judgement. Intelligent forethought can prevent injury.

If freezing does occur, proper rewarming in warm water will give maximum benefit. The injured limb should be handled gently and a medical judgement be made of the extent of the injury and the need for further treatment.

Reference

1. Frostbite information compiled and distributed by the Providence Hospital Thermal Unit.

Physical Agent Data Sheet (PADS)

Heat Stress

Description

Heat stress is caused by working in hot environments like laundries, bakeries, or around boilers or incinerators. Four environmental factors affect the amount of heat stress felt by employees in hot work areas: temperature, humidity, radiant heat (such as from the sun or a furnace), and air velocity. How well or how poorly an individual reacts to heat stress is dependent on personal characteristics such as age, weight, fitness, medical condition, and acclimatization.

The body has several methods of maintaining the proper internal body temperature. When internal body temperature increases, the circulatory system reacts by increasing the amount of blood flow to the skin so the extra heat can by given off.

Sweating is another means the body uses to maintain stable internal temperatures. When sweat evaporates, cooling results. However, sweating is effective only if the humidity level is low enough to permit evaporation and if the fluids and salts lost are replaced.

Health Effects—Heat Disorders

Heat stroke, the most serious health problem for workers in hot environments is caused by the failure of the body's internal mechanism to regulate its core temperature. Sweating stops and the body can no longer rid itself of excess heat. Signs include: mental confusion, delirium, loss of consciousness, convulsions or coma; a body temperature of 106 degrees Fahrenheit or higher; and hot dry skin which may be red, mottled or bluish. Victims of heat stroke will die unless treated promptly. While medical help should be called, the victim must be removed immediately to a cool area and his/her clothing soaked with cool water. He/she should be fanned vigorously to increase cooling. Prompt first aid can prevent permanent injury to the brain and other vital organs.

Heat exhaustion develops as a result of loss of fluid through sweating when a worker has failed to drink enough fluids or take in enough salt, or both. The worker with heat exhaustion still sweats, but experiences extreme weakness or fatigue, giddiness, nausea, or headache. The skin is clammy and moist, the complexion pale or flushed, and the body temperature normal or slightly higher. Treatment is usually simple: the victim should rest in a cool place and drink salted liquids. Salt tablets are not recommended. Severe cases involving victims who vomit or lose consciousness may require longer treatment under medical supervision.

Heat cramps, painful spasms of the bone muscles, are caused when workers drink large quantities of water but fail to replace their bodies' salt loss. Tired muscles, those used for performing the work, are usually the ones most susceptible to cramps. Cramps may occur during or after working hours and may be relieved by taking salted liqids by mouth or saline solutions intravenously for quicker relief, if medically determined to be required.

Fainting may be a problem for the worker unacclimatized to a hot environment who simply stands still in

the heat. Victims usually recover quickly after a brief period of lying down. Moving around, rather that standing still, will usually reduce the possibility of fainting.

Heat rash, also known as prickly heat, may occur in hot and humid environments where sweat is not easily removed from the surface of the skin by evaporation. When extensive or complicated by infection, heat rash can be so uncomfortable that it inhibits sleep and impairs a worker's performance or even results in temporary total disability. It can be prevented by showering, resting in a cool place, and allowing the skin to dry.

Medical Conditions Aggravated By Exposure to Heat

Persons with heart or circulatory diseases or those who are on "low salt" diets should consult with their physicians prior to working in hot environments.

Preventing Heat Disorders

One of the best ways to reduce heat stress on workers is to minimize heat in the workplace. However, there are some work environments where heat production is difficult to control, such as when furnaces or sources of steam or water are present in the work area, or when the workplace itself is outdoors and exposed to varying warm weather conditions.

Acclimatization

Humans are, to a large extent, capable of adjusting to the heat. This adjustment to heat, under normal circumstances, usually takes about 5 to 7 days, during which time the body will undergo a series of changes that will make continued exposure to heat more endurable.

On the first day of work in a hot environment, the body temperature, pulse rate, and general discomfort will be higher. With each succeeding daily exposure, all of these responses will gradually decrease, while the sweat rate will increase. When the body becomes acclimated to the heat, the worker will find it possible to perform work with less strain and distress.

Gradual exposure to heat gives the body time to become accustomed to higher environmental temperatures. Heat disorders in general are more likely to occur among workers who have not been given time to adjust to working in the heat or among workers who have been away from hot environments and who have gotten accustomed to lower temperatures. Hot weather conditions of the summer are likely to affect the worker who is not acclimatized to heat. Likewise, workers who return to work after a leisurely vacation or extended illness may be affected by the heat in the work environment. Whenever such circumstances occur, the worker should be gradually reacclimatized to the hot environment.

Lessening Stressful Conditions

Many industries have attempted to reduce the hazards of heat stress by introducing engineering controls, training workers in the recognition and prevention of heat stress, and implementing work-rest cycles. Heat stress depends, in part, on the amount of heat the worker's body produces while a job is being performed. The amount of heat produced during hard, steady work is much higher than that produced during intermittent or light work. Therefore, one way of reducing the potential for heat stress is to make the job easier or lessen its duration by providing adequate rest time. Mechanization of work procedures

can often make it possible to isolate workers from the heat source (perhaps in an air-conditioned booth) and increase overall productivity by decreasing the time needed for rest. Another approach to reducing the level of heat stress is the use of engineering controls which include ventilation and heat shielding.

Number and Duration of Exposures

Rather than be exposed to heat for extended periods of time during the course of a job, workers should, wherever possible, be permitted to distribute the workload evenly over the day and incorporate work-rest cycles. Work-rest cycles give the body an opportunity to get rid of excess heat, slow down the production of internal body heat, and provide greater blood flow to the skin.

Workers employed outdoors are especially subject to weather changes. A hot spell or a rise in humidity can create overly stressful conditions. The following practices can help to reduce heat stress:

Postponement of nonessential tasks

Permit only those workers acclimatized to heat to perform the more strenuous tasks, or

Provide additional workers to perform the task keeping in mind that all workers should have the physical capacity to perform the task and that they should be accustomed to the heat.

Thermal Conditions in the Workplace

A variety of engineering controls can be introduced to minimize exposure to heat. For instance, improving the insulation on a furnace wall can reduce its surface temperature and the temperature of the area around it. In a laundry room, exhaust hoods installed over those sources releasing moisture will lower the humidity in the work area. In general, the simplest and least expensive methods of reducing heat and humidity can be accomplished by:

Opening windows in hot work areas,

Using fans, or

Using other methods of creating airflow such as exhaust ventilation or air blowers.

Rest Areas

Providing cool rest areas in hot work environments considerably reduces the stress of working in those environments. There is no conclusive information available on the ideal temperature for a rest area. However, a rest area with a temperature near 76 degrees Fahrenheit appears to be adequate and may even feel chilly to a hot, sweating worker, until acclimated to the cooler environment. The rest area should be as close to the workplace as possible. Individual work periods should not be lengthened in favor of prolonged rest periods. Shorter but frequent work-rest cycles are the greatest benefit to the worker.

Drinking Water

In the course of a day’s work in the heat, a worker may produce as much as 2 to 3 gallons of sweat. Because so many heat disorders involve excessive dehydration of the body, it is essential that water intake during the workday be about equal to the amount of sweat produced.

Most workers exposed to hot conditions drink less fluids than needed because of an insufficient thirst drive. A worker, therefore, should not depend on thirst to signal when and how much to drink. Instead, the worker should drink 5 to 7 ounces of fluids every 15 or 20 minutes to replenish the necessary fluids in the body. There is no optimum temperature of drinking water, but most people tend not to drink warm or very cold fluids as readily as they will cool ones. whatever the temperature of the water, it must be palatable and readily available to the worker. Individual drinking cups should be provided, never use a common drinking cup.

Heat acclimatized workers lose much less salt in their sweat than do workers who are not adjusted to the heat. The average American diet contains sufficient salt for acclimatized workers even when sweat production is high. If, for some reason, salt replacement is required, the best way to compensate for the loss is to add a little extra salt to the food. Salt tablets should not be used. CAUTION: PERSONS WITH HEART PROBLEMS OR THOSE ON A "LOW SODIUM" DIET WHO WORK IN HOT ENVIRONMENTS SHOULD CONSULT A PHYSICIAN ABOUT WHAT TO DO UNDER THESE CONDITIONS.

Protective Clothing

Clothing inhibits the transfer of heat between the body and the surrounding environment. Therefore, in hot jobs where the air temperature is lower than skin temperature, wearing clothing reduces the body's ability to lose heat into the air.

When air temperature is higher than skin temperature, clothing helps to prevent the transfer of heat from the air to the body. The advantage of wearing clothing, however, may be nullified if the clothes interfere with the evaporation of sweat.

In dry climates, adequate evaporation of sweat is seldom a problem. In a dry work environment with very high air temperatures, the wearing of clothing could be an advantage to the worker. The proper type of clothing depends on the specific circumstance. Certain work in hot environments may require insulated gloves, insulated suits, reflective clothing, or infrared reflecting face shields. For extremely hot conditions, thermally-conditioned clothing is available. One such garment carries a self-contained air conditioner in a backpack, while another is connected to a compressed air source which feeds cool air into the jacket or coveralls through a vortex tube. Another type of garment is a plastic jacket which has pockets that can be filled with dry ice or containers of ice.

Recommended Exposure Limits

These Threshold Limit Values (TLVS) refer to heat stress conditions under which it is believed that nearly all workers may be repeatedly exposed without adverse health effects. The TLVs shown in Table I are based on the assumption that nearly all acclimatized, fully clothed workers with adequate water and salt intake should be able to function effectively under the given working conditions without exceeding a deep body temperature of 38 degrees Celsius (100.4 degrees Fahrenheit).

Since measurement of deep body temperature is impractical for monitoring the workers' heat load, the measurement of environmental factors is required which most nearly correlate with deep body temperature and other physiological responses to heat. At the present time, Wet Bulb Globe Temperature Index (WBGT) is the simplest and most suitable technique to measure the environmental factors. WBGT

values are calculated by the following equations:

Outdoors with solar load: WBGT = 0.7 NWB + 0.2 GT + 0.1 DB

Indoors or Outdoors with no solar load: WBGT = 0.7 NWB + 0.3 GT

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Where:  WBGT = Wet Bulb Globe Temperature Index
        NWB = Natural Wet Bulb Temperature
        DB = Dry Bulb Temperature
        GT = Globe Temperature
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The determination of WBGT requires the use of a black globe thermometer, a natural (static) wet-bulb thermometer, and a dry bulb thermometer.

Higher heat exposures that shown in Table I are permissible if the workers have been undergoing medical surveillance and it has been established that they are more tolerant at work in heat than the average worker. Workers should not be permitted to continue their work when their deep body temperature exceeds 38.0 degrees Celsius (100.4 degrees Fahrenheit).

Table 1
Permissible Heat Exposure Threshold Limit Values
(Values are given in degrees Centigrade WBGT (Fahrenheit)]

	Work Load		
Work- Rest Regimen	**Light**	**Moderate**	**Heavy**
Continuous work	30.0 (86.0)	26.7 (80.1)	25.0 (77.0)
75% Work, 25% Rest/Hour	30.6 (87.1)	28.0 (82.4)	25.9 (78.6)
50% Work, 50% Rest/Hour	31.4 (88.5)	29.4 (85.0)	27.9 (82.2)
25% Work, 75% Rest/Hour	32.2 (90.0)	31.1 (88.0)	30.0 (86.0)

References

1. "Working in Hot Environments," US Department of Health and Human Services, Public Health Service, Centers for Disease Control, National Institute for Occupational Safety and Health, 1986.
2. "Threshold Limit Values and Biological Exposure Indices for 1986 - 1987," American Conference of Governmental Industrial, Hygienists, 6500 Glenway Avenue, Building D-7, Cincinnati, OH 45211-4438.

APPENDIX C

DAILY TAILGATE MEETING FORM

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Daily Tailgate Meeting Form

Project Title:	Date/Time:
Site Location:	Muster Point:
AES Site Manager:	AES SSHO:
Work to be performed:	

Potential Safety and Health Hazards		
Hazard	Considerations	Comments
CRITICAL		
☐ Sub-surface work	☐ Utility location complete	
☐ Confined space entry	☐ Access and egress safe ☐ Retrieval device in place	
☐ Work over 6 ft	☐ Fall protection in place	
☐ Electrical/Mechanical Isolation	☐ Lockout/Tagout complete	
☐ Hot work	☐ Flame retardant clothing	
☐ Excavation entry	☐ Sloping, benching complete	
GENERAL		
☐ Slips/trips & falls	☐ Hazard areas acknowledged	
☐ Travel to and from site	☐ Load secured ☐ Vehicle in good working condition	
☐ Electrical	☐ GFCI/Power shut-off switch or breaker	
☐ Overhead hazards	☐ Power lines, loose items, pipelines, etc.	
☐ Power tools/hand tools	☐ Inspected & in good working condition ☐ Operator familiar with proper use	
☐ Heavy equipment	☐ Communication/eye contact w/ operator	
☐ Motor vehicles/traffic	☐ Signs/Cones/Barriers ☐ Reflective and/or bright colored clothing	
☐ Pinch Points	☐ Hand protection	
☐ Cuts/Abrasions	☐ First Aid Kit	
PHYSICAL		
☐ Adverse weather conditions	☐ Proper clothing available	
☐ Noise	☐ Hearing protection	
☐ Vibration	☐ Anti-vibration gloves	
☐ Hazardous atmospheres	☐ Atmospheric monitoring devices (i.e. PID)	
☐ Flam./explosive materials	☐ Correct storage/secure if transporting	
☐ Manual lifting	☐ Proper lifting techniques	
☐ Oxygen deficiency	☐ Monitoring device	
	CHEMICAL	
☐ Contaminants of concern	☐ Appropriate PPE ☐ Air monitoring as applicable	
☐ Hazardous materials	☐ Spill prevention measures in place ☐ MSDS readily available	
☐ Particulates (fibers/dust)	☐ Dust control measures	
☐ Pressurized lines (hydraulic)	☐ Spill prevention measures in place	
☐ Gases/Vapors	☐ Monitoring devices	

Daily Tailgate Meeting Form

BIOLOGICAL		
☐ Wildlife interaction	☐ Right of way to wildlife/avoid interaction ☐ Bear spray/fog horn	
☐ Insects	☐ Repellent	
☐ Plant interaction	☐ Avoid contact if possible	
☐ Sanitation	☐ Location of safe use	
☐ Travel over sensitive areas	☐ Minimize unnecessary impacts	

Hazard Controls - PPE		
☐ Hard hats	☐ Foot protection (i.e. steel toes)	☐ H2S monitor, PID, Multi-gas meter
☐ Safety glasses	☐ Hand (i.e anti-vibration, nitrile)	☐ Respirators or dust guard
☐ Hearing protection	☐ Flotation devices	☐ Fall protection
☐ Fire resistant clothing	☐ Slip Protection (ice grippers)	☐ Face Shields
☐ Reflective vest	☐ Other:	☐ Other:

Other considerations		
☐ Spill kit	☐ Means of communication	☐ Decontamination Procedures
☐ Fire extinguisher	☐ Ensure necessary permits are in place	☐
☐ Safe site access/egress	☐ Eating, drinking, smoking locations	
☐ First aid kit	☐ Proper waste disposal	

Emergency contacts:		
Police:	Ambulance:	Fire:
Nearest Medical Facility:		

I agree to work safe and to work smart:

	ATTENDEE:	SIGNATURE:	ORGANIZATION:
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APPENDIX D

ACCIDENT INJURY, ILLNESS, AND INCIDENT REPORT

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Form SH 7-6

ACCIDENT / INJURY / ILLNESS / INCIDENT REPORT

The attached Report of Accident must be completed and forwarded to the AGSC Corporate Office ***within 24 hours*** *of a reported accident, injury, illness, near-miss or related incident (to include motor vehicle accident (MVA), environmental release or threatened release, regulatory inspection and/or notice of violation).*

Check one
Initial Report: ☐
Update: ☐
Final Report: ☐

INCIDENT ANALYSIS REPORT

Section 1 – Incident Type (mark all that apply)

☐ Near Miss ☐ First-aid Case ☐ Medical Treatment ☐ Hospitalization Required
☐ Fatality ☐ Day Away Case ☐ Restricted/Transfer Case ☐ Environmental Release
☐ Regulatory Inspection ☐ Notice of Violation ☐ Other (please describe): _____

Section 2 – General Information

Local Office ID: _____ Date of Incident: _____ Military Time: _____ Day of Week: _____

Report Date: _____ Date injury/illness reported to employer: _____

If date reported is not date of injury/illness or medical treatment sought at a later date, explain:

Ahtna Supervisor on Duty: _____

Ahtna supervisor at the Scene of Incident: _____

Location where incident occurred: _____

Is this a Company controlled work site: ☐ Yes ☐ No

Section 3 – Affected Employee Information (Include injured person, driver/operator, or employee whose activities resulted in the incident. Use another page to provide information for additional employees)

Employees Full Name: _____ Sex: ☐ M ☐ F Date of Birth:_____

Employees Home Address: _____ Ahtna Employee: Yes ☐ No ☐

Job Title: _____ Hire Date: _____

Department:_____ Project Manager: _____ Client: _____

Office where employee works from: _____ Immediate Supervisor: _____

Time employee began work: _____ Hrs. employee worked during last 7 days: _____

Section 4 – Injury/Illness Information

If an **injury or illness** - describe the part of the body that was affected and how it was affected:

First Aid Provided: ☐ Yes ☐ No If Yes: On-site ☐ Off-site ☐ Who Provided First Aid: _____

Was employee treated by a physician or in Emergency Room? ☐ Yes ☐ No

If Yes, was medical treatment provided: On-site ☐ Doctors Office ☐ Hospital ER ☐ _____

Name or Person(s) providing treatment: _____

Address where treatment was provided (include hospital name if applicable): _____

Was employee hospitalized overnight as an in-patient? ☐ Yes ☐ No

Last day employee worked: _____ Date employee returned to work: _____

If injury/illness resulted in death, what is the date of death? _____

Section 5 – Incident Description (Attach and number additional pages, as needed, to ensure all details related to incident captured.)

A. NATURE of INJURY

SPECIFIC INJURY/ILLNESS and PART of BODY AFFECTED, MEDICAL DIAGNOSIS if available (e.g. Second degree burns on right arm, tendonitis on left elbow, lead poisoning) .

B. LOCATION

B (1): LOCATION WHERE EVENT or EXPOSURE OCCURRED (Number, Street, City, Zip)

B (2): DEPARTMENT / FUNCTIONAL UNIT WHERE EVENT or EXPOSURE OCCURRED (e.g.. Office, Environmental, Construction, SLD). Identify :

B (3): IS this an AHTNA CONTROLLED JOBSITE? YES ☐ NO ☐

B (4): OTHER WORKERS INJURIED or ILL in the EVENT? YES ☐ NO ☐

C. SOURCE of INJURY

C (1): EQUIPMENT, MATERIALS and CHEMICALS the EMPLOYEE WAS USING WHEN EVENT or EXPOSURE OCCURRED (e.g.. welding torch, hand tool, heavy equipment, scaffold)

C (2): WHAT OBJECT or SUBSTANCE DIRECTLY HARMED the EMPLOYEE?

D. WHAT HAPPENED?

D (1): SPECIFIC ACTIVITY the EMPLOYEE was PERFORMING WHEN EVENT or EXPOSURE OCCURRED (e.g. welding seams of metal forms, loading boxes onto truck, cutting materials).

D (2): What was the EMPLOYEE(s) DOING JUST PRIOR to the INCIDENT?

E. HOW INCIDENT HAPPENED / SEQUENCE OF EVENTS

HOW INJURY/ILLNESS OCCURRED. DESCRIBE SEQUENCE of EVENTS. SPECIFY OBJECT or EXPOSURE WHICH DIRECTLY PRODUCED the INJURYIILLNESS, e.g.. Worker stepped back to inspect work and slipped on scrap material. As he fell, he brushed against fresh weld, and burned right hand. USE SEPARATE SHEET IF NECESSARY

F. EQUIPMENT DAMAGE

F (1): LIST any DAMAGED EQUIPMENT or PROPERTY (other than motor vehicles), MODEL and SERIAL NUMBER and ESTIMATED VALUE. List the names of any witnesses, their employer, and a local/company telephone number or address:

G. WITNESSES / OTHERS INVOLVED IN INCIDENT

G (1): LIST the NAMES of ALL PERSONS INVOLVED in the INCIDENT, EMPLOYER and CONTACT INFORMATION:

G (2): LIST the NAMES of any WITNESSES, their EMPLOYER, and CONTACT INFORMATION (e.g. phone number, address):

Section 6 - Incident Analysis

A. Was a Job (Activity) Hazard Analysis (JHA/AHA) completed for the work being performed? YES ☐ NO ☐ Who prepared the JHA?

Explain:

B. When and who was the last safety officer (i.e. LSHC, supervisor, ES&H Manager, etc.) at your work site?

Explain:

C. Did the person **directly related** to the incident have site specific safety training, and when? (specify topics covered)

Identify Training:

Section 7 - Incident Investigation Results

#	**Causal Factors** (*Any behavior, condition, act, or omission that starts or sustains an accident occurrence. Avoiding or eliminating would prevent the occurrence. Examples: taking shortcuts, operating equipment at unsafe speed, not following established work practices, inadequate training, inadequate procedures, and equipment/material failure.*) (Attach and number any additional pages, as needed, to completely address this section.)
1	
2	
3	
4	

Root Cause(s) Analysis (The items below represent major root cause categories which have been determined to be Less Than Adequate (LTA). A more detailed determination of the root cause will be facilitated, if needed, by your ES&H Manager.)

1. Equipment Reliability Program Implementation
2. Administrative / Management Systems
3. Immediate Supervision
4. Training
5. Human Factors Engineering (Ergonomics)
6. Communications
7. Personal Performance

Root Cause #	**Corrective Actions to be taken** (Attach additional pages, as needed, to completely address this section)	**Responsible Person**	**Proposed Completion Date**	**Closed on Date**	**Verified by and Date Verified**

Section 8 – Signatures / Approvals - *Note: SH&E Mgr to Copy CEO on OSHA recordable incidents.* Date Sent

Incident investigated / reviewed by (signatures):			
		Local S&H Coordinator:	Date:
Employee's Supervisor:	Date:	SH&E Manager:	Date:
Project Manager:	Date:	Work Comp Administrator:	Date:

Add any additional Comments in this Section:

VEHICLE INCIDENT REPORT

Section 1 - General Information

Time incident occurred: _____ ☐ AM ☐ PM | ☐ Dark ☐ Light | Road Condition: ☐ Dry ☐ Wet | Date of Incident: _____

Were police summoned to scene? ☐ Yes ☐ No Police Department and Location: _____

Report #: _____ Officer's Name and Badge Number: _____

Section 2 - Company Driver and Vehicle

Driver's Name: _____ D/L # _____ State _____

Driver's home office address: _____ Driver's Phone # _____

Company Vehicle # _____ Year _____ Model _____ License # _____ State _____

Company car? ☐ Yes ☐ No Owned by employee? ☐ Yes ☐ No

Leased/Rented from _____

Passenger/Witness Name(s) _____ Address: _____ Phone: _____

Passenger/Witness Name(s) _____ Address: _____ Phone: _____

Passenger/Witness Name(s) _____ Address: _____ Phone: _____

Damage to vehicle (identify and attach photos): _____

Injuries to employee(s): _____

Injuries to others: _____

Vehicle was being used for: Company business ☐ Yes ☐ No Personal business ☐ Yes ☐ No

Towed: ☐ Yes ☐ No By Whom: _____ To Where: _____

Section 3 - Other Driver and Vehicle Information

Driver's Name: _____ D/L # _____ State _____

Driver's home office address: _____ Driver's Phone # _____

Telephone: Home _____ Work _____ Cell _____

Reg. Owner's Name: _____ Address _____ City _____ State _____
(verify registration document)

Other Vehicle: Make _____ Model _____ Year _____ License # _____ State _____

Insurance company name: _____ Address _____ Phone _____

Policy No. _____ Contact Person _____ Phone

Passenger/Witness Name(s) _____ Address: _____ Phone: _____

Passenger/Witness Name(s) _____ Address: _____ Phone: _____

Injuries to other driver/passengers [Identify person(s), comments, extent of injuries as known]:

_

Damage: (*Make a sketch of incident scene, with street names. Note pre-existing damage and take pictures if possible.* ***Attach more pages as needed****)*

	Indicate the vehicles involved and direction of travel using the following symbols (i.e. → = Direction) V1 **Vehicle 1 (your vehicle)** V2 **Vehicle 2 (other vehicle)** → = East ↑= North  = Pedestrian (draw stick figure)

Section 4 – Approvals (signatures required)

Incident investigated / reviewed by (signatures):	
Employee(s): Date:	Local S&H Coordinator: Date:
Employee's Supervisor: Date:	ES&H Manager: Date:
Project Manager: Date:	ES&H Manager sends a copy to CEO for injury incidents and/or accidents resulting in damages that exceed $1,000. Date Sent:

Things to Do First in the Event of a Motor Vehicle Incident

1. Most important: **STOP.**
2. **Call 911 if there are injuries.**
3. Call for an officer if the incident occurred on public property (streets, highways or roads). Disputes often arise between the parties involved as to who was at fault; therefore, a police report is important. If an officer is unable to attend the scene of the accident, a counter police report may be filed at most stations. Insurance companies rely on police reports to determine liability.
4. Complete the Incident Investigation Report and the Vehicle Incident Report forms. It is important that both these forms are completed in detail. Include a diagram of the incident on the back of the report. Incomplete information may lead to delays in processing associated claims and in preventing this type of incident from occurring again.
5. Express no opinion as to who was at fault. This is for the insurance companies to determine.
6. Give only information that is required by the authorities or as directed by AHTNA contractual requirements.
7. Sign only those statements required by the authorities or as directed by AHTNA contractual requirements. Do not sign away your rights or the company's rights.
8. If you are injured or think you were injured, tell your supervisor and see a physician. Your supervisor will notify AHTNA's Worker's Compensation insurance carrier, your ES&H Manager and the Corporate Director of ES&H by phone, email or fax. For additional instructions on what to do, contact AHTNA's ES&H office at (916) 372-2000.
9. Your supervisor will forward both completed incident reports immediately to **y**our ES&H Manager.